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UNIVERSITY OF ALBERTA

Analysis of Forest Land Aggregation Methods for Timber Supply Modelling

BY

Se-Kyung Chong

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND
RESEARCH IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR
THE DEGREE OF Doctor of Philosophy

DEPARTMENT OF FOREST SCIENCE

EDMONTON, ALBERTA

SPRING, 1991

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THE UNDERSIGNED CERTIFY THAT THEY HAVE READ, AND RECOMMEND TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH FOR ACCEPTANCE, A THESIS ENTITLED Analysis of Forest Land Aggregation Methods for Timber Supply Modelling SUBMITTED BY Se-Kyung Chong IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF Doctor of Philosophy

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Dedication

To my parents, Dae-Sung and Song, my wife, Hyo-Sang and my daughters, You-Sun and You-Jin.

ABSTRACT

The difference in compartment based and stand based land classification on the predicted allowable cuts resulting from various timber supply models has recently been recognized as a potential problem. The only work on this problem is by Jamnick (Jamnick 1988 and Jamnick *et al.* 1990). Using a forest of about 1000 hectares, this research found that larger present values were predicted using stand based classification, but that the differences diminished as the number of management choices increased. A number of questions still remain on the applicability of these results to large forest management agreement (FMA) holders in Alberta: (1) are the results from the previous study appropriate for a large scale (10^6 hectares) industrial forest such as an FMA?, (2) what is the predicted loss in allowable cut of using compartment based management units instead of stand based management units?, (3) how important are forest road access constraints on the optimal timber harvest schedule?, (4) what are the differences between compartment based and stand based management units in regards to data aggregation and computer operation?, and (5) do upper limit constraints on costs per period affect the relationships above?.

In order to address some of these questions, an FMA in Alberta of about 10^6 hectares was used to examine the difference in the volume of the predicted allowable cut

between various scenarios of compartment based and stand based land classification and various scenarios of constraints over time on access, cost, and volume flow. Results of this study support those of Jamnick *et al.* (1990) in that larger allowable cuts (1.31 to 2.10%) are predicted using models with stand based units. Additionally, increases in predicted allowable cut of 1.33 - 2.13% were found if the five independent allowable cut units on the forest were condensed to one allowable cut unit. Removal of the current access constraints led to an increase of predicted cut of 15 - 16%. Maximum cost constraints per period were found to; (a) on average, increase predicted differences from unconstrained stand based versus compartment based analysis, (b) decrease differences found by reducing the number of allowable cut units, and (c) show no meaningful measurable results with access constraint analysis.

Differences in computer time (cost) for determining solutions and differences in data preparation effort were examined. Stand based analysis for this study led to larger problems, which took more computer time to solve. When logging and hauling cost are included in the analysis, data for these stand based methods are more difficult to develop as well. However, in spite of the increased costs and effort, it is estimated that the actual increase in cost is from one third to one half of a cent per cubic meter gain in allowable cut.

Use of the cost constraints led to the ability to develop marginal cost of allowable cut curves to compare stand based and compartment based analyses. Individual managers can use these curves as a policy decision making tool to determine which type of land classification analysis is best (most economical per cubic meter cut) as a function of allowable cut level. These curves can also help the individual manager to set a price policy for the external purchase of wood supplies.

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1. Introduction

1.1 Identification of the Problems

Forest land classification, in terms of stand aggregation versus area aggregation for timber management planning, has been questioned in recent years (Davis and Johnson 1987, Jamnick 1988). This concern has been raised because every aggregation of forest land has different physical, vegetative or developmental characteristics. Because boundary designations of management units to be managed for timber production are arbitrary, the final estimated timber volume depends on the spatial specifications of the aggregated areas. In the short-term and for forests composed of diverse types, the effect of boundary designations may be much more crucial than in forests composed of similar, generally homogeneous characteristics.

Managing a forest usually involves optimizing some goal (usually with an economic component) to best fulfill the need or desires of either the owners or users of the forest. Often the goal is to maximize the present net value, undiscounted value or volume of harvest output. These cases are often solved with constraints on cost, volume, and value per intra time period. In some cases, the goal, however, may be to provide specific harvest levels over time at minimum cost. To handle these kinds of management problems, linear programming (LP) is often used because of its ability to optimize outputs under a variety of constraints (Nelson *et al.* 1988). Classifying the forest land area on the basis of geo-physical or biological characteristics has been essential in making reasonably sized problems for linear programming models for timber management planning. The problem size for an LP timber harvest scheduling model depends largely on the number of timber classes, which is a determining factor for the number of decision variables. This means that as the number of timber type classes increase, the decision variables in an LP model increase proportionately, requiring more costly runs to get a solution. Computer system capacity, as well as computer budget limitations, are crucial factors in setting up mathematical programming problems for optimal timber harvest scheduling of real, large-scale forest management areas.

Two approaches to forest land classification have been considered in the context of linear programming for timber harvest scheduling models. One approach is to use user-defined biological attributes to aggregate similar kinds of homogeneous stands. This kind of grouping is called stand or strata based aggregation and the pieces of this aggregation are usually non-contiguous. The other approach is to use user-defined spatial or economic information, such as drainage, topography, accessibility, merchantability and logging chance, to aggregate areas based on similar characteristics. This kind of grouping is called compartment or area aggregation and the pieces of this aggregation are usually contiguous. For the remainder of this study, the terms stand and compartment will be used to describe these two types of aggregations, respectively.

Growth and yield predictions are normally more reliable for stand based aggregation, because the vegetation types tend to be more homogeneous with this method. Economic predictions or any other predictions, where spatial location is of importance, tend to be more reliable using compartment based aggregation, since each unit is at a known location. The obvious question is what is the trade-off between two sets of forest land classification methods, when they are incorporated into the LP models to be developed for optimal timber harvest scheduling. So far, only one study (Jamnick *et al.* 1990) has dealt with the effects of different forest land classification methods on timber harvest scheduling. Jamnick's (1990) study used a real, approximately 1000 ha forest, sub-divided into 26 stand types and 29 to 85 compartments to identify the differences between stand based aggregation and compartment based aggregation. One should note that the number of compartments were always greater than the number of stand types. In Canada, typical large forest areas managed by companies have many more stand types than compartments.

If one has a large scale industrial forest that has a large number of stand types which are a mixture of site productivities and species, organized into several compartment based working circles[1] each made up by many different compartments[2] : (1) what is the effect on allowable cut of switching from compartment based units to stand based units?, (2) what is the effect of elimination of working circle boundaries?, (3) what are the impacts of access constraints, reflecting road construction, on the optimal timber harvest schedule?, (4) what are the differences between compartment based and stand based forest land classification in regards to data manipulation and computer operation for LP models to be developed for timber management on a large-scale forest land base, with and without economic or access considerations?, and (5) how important are maximum average cost per period constraints related to the answers to the above questions? Do these cost constraints ameliorate or exaggerate the differences as compared to conditions with no cost constraints?.

---

[1] A working circle generally represents an independent forest administrative unit, and numerous practical advantages result from stabilization of wood flows within such unit (Ware and Clutter 1971). This is the smallest unit for which a sustainable allowable cut is calculated.

[2] A compartment is an area based subunit of working circle which is a operating management unit usually determined by vegetative characteristics, topographical features and operational considerations.

1.2 Organization of the Thesis

Chapter 2 provides theoretical foundations on forest land aggregation for timber supply modelling and economic timber supply. Chapter 3 includes the objectives of this study, and chapter 4 contains a description of the methodology uniquely developed for this study. Chapter 5 contains descriptions of the case study area, data requirements and linear programming model structure which will be used to evaluate the problems. Chapter 6 contains a presentation of the effects of different forest land aggregation methods and access concerns on allowable cut, associated with timber operating costs and develops the timber supply curve, while chapter 7 contains final remarks.

2. Theoretical Foundations

2.1 Timber Supply Modelling and Forest Land Classification

Linear programming models have been one of the most common ways of evaluating long-term, large-scale timber supply problems. These timber supply problems are typically, as stated earlier, ones that maximize output subject to constraints or minimize costs subject to constraints (In certain special cases, the problems are the dual of each other). Computer-based linear programming models such as

TIMBER RAM (Navon 1971), Max-Million (Clutter 1968), and MUSYC (Johnson and Jones 1979) have focused on determining the optimal allocation of the timber resource.

Computer models have become more complex, as attempts to capture the essence of increasingly complicated, real world situations have evolved. This trend accelerated the development of FORPLAN (Johnson *et al.* 1986), a linear programming based model. FORPLAN was designed to handle other forest-related resources in addition to timber and, it was designed to take into account some spatial concerns by use of allocation zones. Jamnick *et al.* (1990) state that, because of the size of real forest problems, computational limitations allow only a few distinct choices to be considered for each of these allocation zones. Berck and Bible (1984) and Liittschwager and Tcheng (1967) attempted to adopt an efficiency technique, based on decomposition, using the algorithm developed by Dantzig (1963) and Dantzig and Wolfe (1961) in order to reduce the computational burden in terms of time and computer storage.

Many other aspects of optimal timber harvest scheduling, using LP, have been examined. These aspects include optimal harvest scheduling (Curtis 1962, Leak 1964, Loucks 1964, McConnen *et al.* 1966, Beck 1977, Johnson and Scheurman 1977, and Johnson and Tedder 1983), optimal treatment regimes

(Wardle 1965, Buongiorno and Teeguarden 1978), flow constraints (Armstrong *et al.* 1984, Mcquillan 1986, Hof *et al.* 1986, and Allard *et al.* 1988), the effect of the length of planning horizon (Kristoff 1986), economic timber supply analysis (Nautiyal and Pearse 1967, Hrubes and Navon 1976, Michie and McCandless 1986, and Beck *et al.* 1989), the effect of age classes (Barber 1985), forest regulation (Kidd *et al.* 1966 and Hennes *et al.* 1971), budget allocation (Kirby 1978 and Hof *et al.* 1985), industrial forest management planning (Ware and Clutter 1971 and Walker and Lougheed 1985) and multiple use (Leuschner *et al.* 1975, Steuer and Schuler 1978, Mendoza *et al.* 1987, and Paredes and Brodie 1988).

In terms of size of area processed, Ware and Clutter (1971), from their empirical study, state that the aggregated total cutting schedule for several working circles is obviously a suboptimization in comparison to the schedule that would be prepared by scheduling the entire forest holding as a single unit. As well, they explain, based on past practical experience, the loss in present worth caused by the subdivisions of the forest as independent units can be negligible and the use of working circles as independent scheduling units can be justified.

Only recently, however, has anyone paid much attention to the effects of forest land classification (stand based versus compartment based aggregation). Davis and Johnson (1987) state that forest land classification has received little attention historically, despite it being an important component in the determination of the number of decision variables in an LP harvest scheduling model, and that the most common way of aggregating inventory data for LP model use has been by use of stand type strata. This stand based aggregation tends to ignore spatial organization of stands and an analysis based on it produces a management plan that fails to account for the spatial dimension (Chappelle *et al.* 1976). Hokans (1983) states that such an omission may be important to private as well as public forest management and costs of moving harvesting crews and administering widely separated sales make spatial considerations important to commercial endeavors. Mealey *et al.* (1982) indicate that long-term forest-wide harvest level calculated by stand based aggregation tends to overstate timber harvest capability when additional multiple use objectives for the other uses besides timber must be met. Armel (1986) questioned how the allocations represented by the standard, stratum-based FORPLAN solution, in which homogeneous forest units are aggregated, can be implemented within a heterogeneous area represented by a given parcel of national forest land, when the actual operational considerations such as wildlife habitats and harvest adjacency constraints are necessary. There have been some attempts to overcome the above disadvantages of stand based aggregation use in LP models so that the long-term forest wide planning results can be integrated into site specific project planning. These tools are a simulated stand selection method, a random search algorithm and a mixed integer programming or heuristic procedures (Hokans 1983, Tanke 1985, Gross *et al.* 1988, Meneghin *et al.* 1988, Connelly 1988, Nelson *et al.* 1988, O'Hara *et al.* 1989, Nelson *et al.* 1990, Torres-Rojo *et al.* 1990). With the advent of larger computers and geographic information systems (GIS), interest has revived regarding the effects of area based land classification systems. In direct comparisons of stand based aggregation with compartment based aggregation, Jamnick *et al.* (1990) state that forest land classification systems and the number of management choices considered in LP timber harvest scheduling models significantly influence the optimal harvest schedules. They found that: (1) as the management unit size increases, the objective function values decrease, (2) models using stand based decision variables have larger objective function values than models using compartment based management unit decision variables, and (3) as the number of management choices increase, the difference in objective function values between stand based and compartment based management unit models diminishes. Further, they found that the number of management choices was more important than the size of management unit or type of land classification unit in determining optimal present values.

2.2 Economic Timber Supply Development

Under a model of competitive supply, economic theory states that profit is maximized where marginal revenue (MR) equals marginal cost (MC), where the MC curve intersects the MR curve from below. Since the individual firm, as a perfect-competitor, can not affect price by output levels (price-taker), price is equal to marginal revenue. Marginal cost is the extra cost of producing each additional unit of output. Total profit is the difference between total revenue and total cost. Total profit increases as long as the extra revenue brought in from the last unit sold is greater than the extra cost incurred in producing the last unit and is maximized when there is no longer any extra profit to be earned by selling extra output. Therefore, the individual company will produce all units of output with a marginal cost less than price, where maximum profit equilibrium (price = marginal cost) arises (Samuelson 1980).

Applying this theory to a forest operation, and looking only at wood supply, price is essentially fixed in the short run and is given by what the company has determined is the value of wood delivered to the mill. This price would be based on the current market value of the wood products produced, minus processing costs, any fees or charges levied and some type of reasonable profit margin. Marginal cost of wood delivered to the mill is primarily a function of logging and hauling costs.

A marginal cost curve of wood procurement can be derived using a timber supply linear programming based model. The usual way to do this is to minimize cost subject to maintaining a certain level of timber production over time. As a dual problem to this, an exact opposite formulation can be made by maximizing timber output subject to a constraint on timber production cost over time. Once the marginal cost (timber supply) curve is derived, the following considerations can be made.

In order to increase wood output, additional timber would be required and this timber would have to come from longer distances or modified utilization standards, increasing the marginal cost of supplying timber. However, it should be noted that timber may be obtained from sources other than the company's own land. Wood chips or logs could be purchased from other companies or contract loggers. At this point, the first question to a company is what quantities to produce itself and what quantities to purchase. This question can be answered by examining the individual marginal cost curve. If price is greater than the marginal cost of obtaining the extra wood, the company would produce or buy any wood less than this price. The second question would be whether it is worthwhile for the company to increase output to this level. To do this, the company would need to know what the industry's aggregate timber supply curve is. This would be obtained by horizontally summing the individual supply curves. All of the above assumes that the company has the ability to vary levels of production to the amount where maximum profit equilibrium occurs. In this thesis, marginal cost curves in both stand and compartment configurations are developed and compared as part of the overall valuation of boundary designations.

3 Objectives of the Study

To look at the concerns expressed in the previous sections, six main objectives were established for this study;

(1) Identify the effects of working circle boundaries, within a large scale forest land base, on the allowable cut (both direction of change and magnitude of change), using both compartment based land units and stand based units,

(2) Identify the effect of compartment based unit boundaries, within a large scale forest land base, on the allowable cut (both direction of change and magnitude of change) compared to the allowable cut from the forest using stand based units,

(3) Examine the effects of access constraints on the allowable cut (both direction of change and magnitude of change), in order to illustrate the importance of forest road building schedules for timber management,

(4) Investigate how the different forest land classification methods differ in relation to data aggregation and computational efficiency for LP models to be developed for each case,

(5) Demonstrate how maximum average cost level constraints per planning period impact on objectives 1 to 3 above,

(6) Develop timber supply curves, using marginal costs which are derived from stand and compartment analyses.

4. Methodology

4.1 Model Development

The overall approach of this study can be viewed simply by looking at Table 4.1-1. The table indicates 8 different sets of computer runs based on having working circle boundaries considered (Y) or not considered (N), compartment boundaries considered (Y) or not considered (N), and capital access forest road building concerns considered (Y) or not considered (N). Models 1 to 4, that do not include working circle boundaries, need only one LP run to determine a harvest level for the forest. Models 5 to 8, where working circle boundaries are considered, need one LP run for each working circle in the forest to determine a forest wide harvest level. With each of the eight possible models, multiple sets of runs are needed, with different maximum average cost per period constraint levels set, so as to determine the effect of maximum average cost per period on the analyses.

Table 4.1-1. Table of models to be considered

Models	Working circle boundaries	Compartment boundaries	Access concerns	# of LP runs to get forest wide AAC
1	N	N	N	1
2	N	N	Y	1
3	N	Y	N	1
4	N	Y	Y	1
5	Y	N	N	X
6	Y	N	Y	X
7	Y	Y	N	X
8	Y	Y	Y	X

X = # of working circles in forest

4.2 Design of Analysis

Comparison of any pair of model groups (1 with 5, 2 with 6, 3 with 7, or 4 with 8) will allow analyses of and identification of any major reductions in allowable cut due to working circle boundaries. Comparison of any pair of model groups (1 and 3, 2 and 4, 5 and 7, or 6 and 8) will allow examination of the effects of compartment boundaries on allowable cut. Finally, any pair in the sets (1 and 2, 3 and 4, 5 and 6, or 7 and 8) will allow analysis of any major reductions in allowable cut due to the proposed capital forest road building schedule.

5. Case Study

5.1 Introduction

This case study was designed to identify how different timber management boundary designations and forest road access constraints affect the allowable annual cut (AAC), recognizing the current timber management strategies of Weldwood's forest management agreement (FMA) area near Hinton, Alberta. The company has divided the FMA into 5 working circles. Each working circle is a major contiguous land area separated from other working circles by rivers and other major topographical features. An even-flow AAC is calculated for each working circle. If an even-flow AAC were calculated for the whole forest, it is likely to be larger than the sum of the even-flow AACs from the 5 working circles because even-flow from the whole forest does not guarantee even-flow from each working circle (refer to Ware and Clutter 1971). The company has further divided the 5 working circles into 153 compartments[1]. These compartments are contiguous areas of forest land which the company feels have roughly similiar accessibility and broad forest maturity classes (20 - 40 years of age ranges). Each compartment is made up of many stand types in terms of species, stocking, and site index. Since Jamnick *et al.* (1990) have shown that stand based aggregation tends to give larger allowable cuts than compartment based aggregation, there is a possibility that use of compartments may be restricting allowable cuts. Since both working circle and compartment boundaries have been shown to restrict allowable cuts elsewhere, there is a strong possibility that working circle and compartment boundaries, used as forest subdivisions within the FMA, are restricting the sustainable harvest levels.

One major concern for the company is to maintain a sustainable harvest level, with relatively stable, acceptable annual operating costs for timber production. Thus, the company needs to estimate sustainable harvest levels over the planning horizon at various maximum average cost levels and determine the effects of working circle boundaries, compartment boundaries and access constraints on these harvest levels. This study will attempt to determine the effects of each of these three constraints independently. The company can respond to significant boundary effects by modifying boundary designations or to significant access constraints by modifying their capital road building plans.

---

[1] The company has designated 135 compartments, but 18 of these are in the process of being harvested, and thus had to be split into 2 compartments (harvested and not harvested) for use in this study.

The answers to the problems above will be explored and evaluated through a case study of the FMA area, using the MUSYC (Johnson and Jones 1979) linear programming based model, which has been modified at the University of Alberta (Kristoff *et al.* 1987) to handle larger problems and to run on an IBM compatible main frame computer.

5.2 Description of the Study Area

The study area contains approximately 10^6 hectares of forest land located on the eastern slope of the Rocky Mountains. Figure 5.2-1 is a map of the study area and shows its location within Alberta. The net manageable area for conifer timber production is 737,700 ha. The main forest cover types are composed of white spruce (*Picea glauca (Moench) Voss*), black spruce (*Picea mariana (Mill.) B.S.P.*), lodgepole pine (*Pinus contorta Dougl.*), alpine fir (*Abies lasiocarpa (Hook.) Nutt.*) and mixed hardwood-softwood stands, where the hardwood is some mix of trembling aspen (*Populus tremuloides Michx.*), balsam poplar (*Populus balsamifera L.*) and paper birch (*Betula papyrifera Marsh.*). Most of the area is well stocked and consists of the operating compartments, ranging in size from 150 to 23480 ha. The exact numbers of these subdivisions for the whole management area are shown in Table 5.2-1.

5.3 Yield Data

The 2,502 stand types were assigned by the company to one of 60 yield streams. Each of the 60 yield streams represented stands in terms of species, age, site and stocking and was developed by the company by analyzing 3,000 permanent sample plots (PSP) in the case study area. The stand based timber yield data is appended in Appendix I.

The yield streams reflect only one type of harvesting - clearcut. The company regeneration results per yield type are reflected in specific regeneration yield streams as well. Since the only management prescription considered by the company is clearcut and regenerate, the only prescription used in this study is clearcut and regenerate.

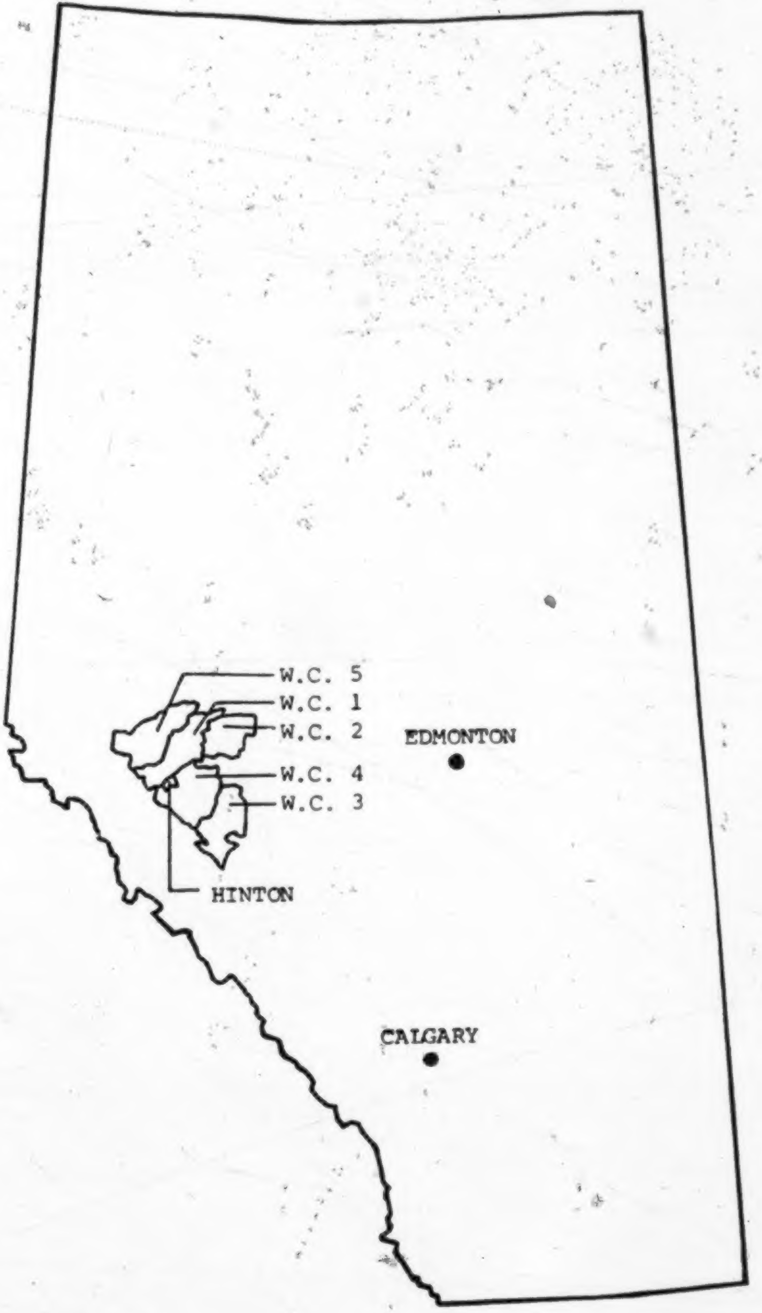
W.C. 5
W.C. 1
W.C. 2
W.C. 4
W.C. 3
HINTON
EDMONTON
CALGARY

Figure 5.2-1 Map of Weldwood FMA in Alberta

Table 5.2-1. The number of subdivisions of the study area

Working Circles	Compartments	Stands
W. C. 1	37	601
W. C. 2	29	447
W. C. 3	20	422
W. C. 4	30	522
W. C. 5	37	510
Total	153	2,502

For each compartment, it was necessary to calculate an area weighted average age and an area weighted average timber yield table for the unit. In order to calculate the average ages and yield estimates of compartments, the following equations were used for combining stands within each compartment;

$$Y_c = \frac{\sum_{i=1}^{s} a_i Y_i}{\sum_{i=1}^{s} a_i} \qquad (1)$$

for each age class

Y_c: the area weighted average per ha yield for each compartment

Y_i: yield per ha in stand i at each age class s : the number of stands within a compartment

a_i: area of stand i in hectares

$$AA_c = \frac{\sum_{i=1}^{s} a_i A_i}{\sum_{i=1}^{s} a_i} \qquad (2)$$

AA_c: the area weighted average age for each compartment

A_i : the age of stand i

A sample set of data and resulting average ages and average yield tables for the compartments in working circle 1 is given in Appendix II.

5.4 Cost Data

Logging and hauling costs from woodlands to the mill were estimated using the models developed for economic timber supply analysis in Alberta (Beck *et al.* 1989). These cost functions represent an industry wide average for Alberta and are used to demonstrate the process, rather than using proprietary data for Weldwood. The woodlands costs are a function of the natural logarithm of average tree volume and the truck to mill costs are expressed as a function of total haul distance and the inverse of standard utilization stump diameter. In order to calculate average tree volume of each timber yield stream at the stand level, the volume of each yield stream by age class was divided by the number of tree stems per ha that are derived from the PSP data of the study area (Appendix III and IV). Average haul distances to the mill were estimated for each compartment and grouped into 20 Km class intervals of haul distance for economic analyses for both stand and compartment analyses (Appendix V). The standard utilization stump diameter was assumed to be an average of 15 cm diameter inside bark as measured 30 cm above ground level. The following equation was used to calculate the average delivered wood costs of compartment based management units;

$$C_c = \frac{\sum_{i=1}^{s} a_i C_i}{\sum_{i=1}^{s} a_i} \quad - (3)$$

for each age class

C_c: the area weighted average per ha cost for each compartment

C_i: cost per ha in stand i at each age class

s : the number of stands within a compartment

a_i: area of stand i in hectares

An example of the calculations for working circle 1 is given in Appendix VI.

5.5 Data Aggregation

5.5.1 Stand Based Analysis

With stand based analysis, a land unit is classified in terms of its' forest vegetation being of a particular age and is associated with a particular yield function. In this case study, there are 60 (Table 5.5-1) different yield functions, each having a possible 16 different age classes (0 to 150 years in 10 year class intervals). Since not all age classes are present for all yield functions, enumeration yields 407 (Table 5.5-2) different possible timber land classes with stand based data aggregation for Model 1, with no economic or access concerns. If one now looks at the 407 different classes in terms of the cost of logging and hauling products to the mill, the 407 classes expand to 1064 timber classes (Table 5.5-2) representing different forest types and ages and different distances from the mill. Additionally, if access concerns are taken into account, stands of the same type, same age and same total haul distance must be classified according to accessibility to the current and proposed future road system (to simulate the capital road building schedule of the company), then the 1064 classes must be expanded to 2,502 timber classes (Table 5.5-2) for Model 2.

If the forest is broken down into sub units (working

Table 5.5-1. The number of yield tables required for the selected models

	Timber yield tables		Economic tables	
	For exist.	For regen.	For exist.	For regen.
Stand based management units for whole area Model 1 & 2	60	60	284	101
Cmpt based management units for whole area Model 3 & 4	153	153	153	153
Stand based management units for each W. C. Model 5 & 6				
W. C. 1	60	60	125	42
W. C. 2	60	60	114	38
W. C. 3	60	60	147	54
W. C. 4	60	60	180	65
W. C. 5	60	60	123	43
Cmpt based management units for each W. C. Model 7 & 8				
W. C. 1	37	37	37	37
W. C. 2	29	29	29	29
W. C. 3	20	20	20	20
W. C. 4	30	30	30	30
W. C. 5	37	37	37	37

Cmpt: Compartment
exist.:existing stands
regen.:regeneration stands

Table 5.5-2. The possible number of timber classes to be considered

	Alternative 1	Alternative 2	Alternative 3
	Without logging & haul cost or access constraints	With logging & hauling costs	With logging and haul cost access and constraints
Stand based management units for whole forest area	(1) 407	(1) 1064	(2) 2502
Cmpt based management units for whole forest area	(3) 153	(3) 153	(4) 153
stand based management units for each working circles	(5)	(5)	(6)
W. C. 1	199	310	601
W. C. 2	167	264	447
W. C. 3	193	313	422
W. C. 4	204	391	522
W. C. 5	164	275	510
Cmpt based management units for each working circles	(7)	(7)	(8)
W. C. 1	37	37	37
W. C. 2	29	29	29
W. C. 3	20	20	20
W. C. 4	30	30	30
W. C. 5	37	37	37

( ) indicates the Table 4.1-1 model number.
Cmpt: Compartment

circles), a smaller, but similar pattern of increased number of forest classes occurs which can be seen in Table 5.5-2 for Models 5 and 6. An example of the classes for Model 5, Alternative 2, working circle 1 is given in Appendix VII.

5.5.2 Compartment Based Analysis

For this analysis, the forest has been divided into 153 compartments. Each compartment unit is considered to grow by a yield table that is an area weighted average of the stands included within that compartment and the age of the unit is the area weighted age of the stands within the unit. These processes were described in Sections 5.3 and 5.4. Since each compartment has only one age, there is no expansion of the 153 yield table types (Table 5.5-1) to get timber classes for Alternative 1 in Table 5.5-2.

As well, since the location of the compartment is fixed in one place, there is no necessary expansion of the timber classes in Alternative 1 to go to Alternative 2 or 3. Each compartment has a unique average logging and hauling cost and each is either accessible or not at any point in time. Thus, Models 3 and 4 from Table 5.5-2 use only 153 timber classes. Similar reasoning maintains the number of timber classes at a smaller fixed number for Models 7 and 8, when the forest is broken into 5 working circles each with a smaller number of compartments (Table 5.5-2).

5.6 MUSYC as a Tool

Potential allowable cuts were calculated using the MUSYC linear programming model, to maximize timber volume output (m^3)[1] for a 150-year planning horizon of fifteen 10-year planning periods, and subject to the following constraints;

(1) maximum average cost per period for the planning horizon,

(2) even-flow (cut in period i+1 should be equal to cut in period i, for all i) or
    non-declining yield (cut in period i+1 is greater than or equal to cut in period i, for all i),

(3) accessibilities reflecting the current forest road building schedule

The maximum per period cost constraints were chosen so as to ensure an upper limit of monetary cost per period for the company's timber operation for the whole planning horizon. The results of these constrained runs can then be used to obtain the marginal cost of allowable cuts to derive an individual timber supply curve. Even-flow harvest policy reflected the timber operation policy of the Alberta Forest Service. Since the even-flow harvest policy was a strict per period constraint for the level of timber harvest, a non-declining yield constraint was also used to examine a more flexible harvest flow policy. The access constraints are in effect for 4 decades, but are totally removed after 5 decades. MUSYC linear programming models developed for this study are all based on a Model I (Johnson and Scheurman 1977) formulation.

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[1] MUSYC could have handled a formulation of minimize costs subject to maintaining a certain timber output over time, but AFS institutional policy constraints dictates the objective of maximizing the AAC subject to cost constraints. When the constraints are all confining, these two problems are the dual of each other.

Assuming computer funding and computer memory size are not limiting, the modified MUSYC model (Kristoff *et al.* 1987) must be further modified to handle all possible run sets for the various scenarios by extending the upper limits of parameters (Tables 5.5-1 and 5.5-2). The changes in numbers of parameters for the MUSYC model are referred to in Table 5.6-1.

Table 5.6-1. Modifications to the MUSYC model

List of parameters	Previous version at U. of A.	Modified
Land classes	15	42
Timber classes	400	3000
Regeneration classes	100	3000
Management alternatives for existing stands	400	3000
Management alternatives for regeneration stands	200	3000
Existing yield tables	100	300
Regeneration yield tables	100	300
Economic tables for existing stands	50	300
Economic tables for regeneration stands	50	300

6. Results and Discussions

This section describes the results from the models developed for this study. First, using both compartment based forest units and stand based forest units, the impacts of working circle and compartment boundaries and access constraints on the allowable cuts are discussed. Second, the model sizes, computational difficulties, data aggregation problems and computer problems are discussed in relation to the different models used in this study. Third, the effects of maximum cost constraints per period on the allowable cut differences above are discussed. Finally, the timber supply curves using the average marginal cost are developed.

Of the eight model types or possible types of runs, it was found that, in spite of having modified MUSYC to handle all of these runs, the University of Alberta computer system LP optimization code could not handle all of the Models. Runs were completed for Models 3, 4, 5, 7, and 8 and Model 1 without incorporating economic and access constraints. The computer LP solution code was unable, due to memory size, to accept Model 1 with economic factors and Models 2 and 6, which consider both economic factors and access concerns. Therefore, the impacts of working circle and compartment boundaries and access constraints on the optimal timber harvest scheduling are examined using Models 3, 4, 5, 7, and 8 and Model 1 without economic or access concerns.

Examining the impact of working circle boundaries on allowable cut, using stand based Models 1 and 5, or compartment based Models 3 and 7, or 4 and 8, demonstrates the effects of more flexibility to meet even-flow requirements by expanding the size of allowable cut unit.

Examining the effect of compartment boundaries on timber harvest scheduling, looking at Models 1 and 3, or 5 and 7, provides any evidence of the real influences of forest land classification methods on timber production. In each paired example above, one uses stands and the other uses compartments as the management units.

The impact of access constraints on optimal timber harvesting are analyzed by comparing Models 3 and 4, or 7 and 8. These pairs evaluate the importance of the forest road access network on the level of optimal timber harvesting and examine the interaction effects of access constraints with both working circle and compartment boundaries.

Even though solutions to the complete Model 1, or Models 2 and 6 were unavailable due to model sizes, it is clear from the above that each of the first three objectives could still be analyzed by at least 2 different sets of models.

Finally, the effects of maximum average cost per period on the above analyses was examined by the multiple sets of runs of each model group, developed sequentially with different maximum average cost per period constraints. From analyses of these runs, marginal cost of allowable cut curves were developed.

6.1 The Effect of Working Circle Boundaries on Allowable Cut with no Access Constraints

6.1.1 At the Compartment Level

This sub-section illustrates the impact of working circle (consisting of area-based management units) boundaries on the allowable cut by comparing Models 3 and 7. The summarized results are shown in Table 6.1-1.

Comparing Model 3 with no working circles with Model 7 with working circle boundaries, there is a 2.13% increase in allowable cut with an even-flow harvest policy. Using a non-declining yield policy rather than even-flow gives an average increase of only 0.95% in allowable cut over the planning horizon, but gives a 2.13% increase in periods 1 to 11. In other words, removing the current working circle boundaries, gives an average increase of 0.95% to 2.13% in the level of timber volume to be harvested per period for the whole planning horizon.

Table 6.1-1.

The effect of working circle boundaries on AAC(10^6 m^3) with no access constraints using compartments

Even-flow constraint

Model 3 (No working circle boundaries, compartment boundaries):

Total allowable cut
for the planning horizon: 226.345 million m^3
AAC per period : 15.090 million m^3

Cut increased per period: 2.13 %

Model 7 (Working circle boundaries, compartment boundaries):

	W.C. 1	W.C. 2	W.C. 3	W.C. 4	W.C. 5
Total	49.876	34.269	44.156	44.546	48.774
AAC	3.325	2.285	2.944	2.970	3.252

Total allowable cut
for the planning horizon: 221.621 million m^3
Total AAC per period : 14.776 million m^3

Non-declining constraint

Model 3:

Total allowable cut
for the planning horizon: 226.345 million m^3
AAC per period : 15.090 million m^3

Ave. cut increased per period: 0.95 %
1st to 11th periods cut increase: 2.13 %

Model 7:

	W.C. 1	W.C. 2	W.C. 3	W.C. 4	W.C. 5
Total	49.876	34.269	45.846	44.546	49.679
Ave. AAC	3.325	2.285	3.056	2.970	3.312
Cut in per. 1st to 11th	3.325	2.285	2.944	2.970	3.252

Total allowable cut
for the planning horizon: 224.216 million m^3
Total AAC per period : 14.948 million m^3

6.1.2 At the Stand Level

This sub-section demonstrates the impact of working circle boundaries on the allowable cut by comparing Models 1 and 5 (consisting of stand-based units). The results are summarized in Table 6.1-2. With Model 1, without working circle boundaries, there is a 1.33% increase in allowable cut, given even-flow harvest policy. In other words, provided that working circle boundaries are present, removing the working circle boundaries gives a 1.33% increment in the allowable cut per period.

Table 6.1-2.

The effect of working circle boundaries on AAC(10^6 m^3) with no access constraints using stands

Even-flow policy

Model 1 (No working circle boundaries, No compartment boundaries):

Total allowable cut for the planning horizon:	229.311 million m^3
AAC per period :	15.287 million m^3

Cut increased per period:	1.33 %

Model 5 (Working circle boundaries, No compartment boundaries):

	W.C.1	W.C.2	W.C.3	W.C.4	W.C.5
Total	51.548	35.407	45.194	45.047	49.091
AAC	3.437	2.360	3.013	3.003	3.273

Total allowable cut for the planning horizon:	226.287 million m^3
Total AAC per period:	15.086 million m^3

6.2 The Effect of Working Circle Boundaries on Allowable Cut with Access Constraints

In this case, access constraints were added to the compartment analysis above, and one can see the results by comparing Models 4 and 8. The summary of the results are in Table 6.2-1. There is an 8.89% increase in allowable cut, given even-flow harvest policy, if working circle boundaries are removed. Since the previous results with no access constraints gave a 1.33%, or 2.13% increase, there is an obvious possible interaction effect here of access with working circle boundaries on the allowable cut.

Additional insight can be gained by comparing Model 7 from the previous analysis in section 6.1.1 with Model 8 of this analysis, given even-flow harvest policy. It becomes very obvious with this examination by working circle that access constraints have minor effects in working circles 1 and 2, major effects in working circles 3 and 4, and a very major effect in working circle 5.

Upon careful analysis of the individual runs, it was found that the even-flow requirement and restricted initial access in each of these three latter units was restricting harvest so much that considerable land base in each working circle was not being harvested. Actual operations would either open access earlier or allow a higher harvest at a later date.

Table 6.2-1.

The effect of working circle boundaries on AAC(10^6 m^3) with access constraints

Even-flow constraint

Model 4 (No working circle boundaries, compartment boundaries):

Total allowable cut for the planning horizon: 196.031 million m^3
AAC per period : 13.069 million m^3

Cut increased per period: 8.89 %

Model 8 (Working circle boundaries, compartment boundaries):

	W.C. 1	W.C. 2	W.C. 3	W.C.74	W.C. 5
Total	49.505	33.910	32.332	36.280	28,011
AAC	3.300	2.261	2.155	2.419	1.867

Total allowable cut for the planning horizon: 180.038 million m^3
Total AAC per period : 12.002 million m^3

Non-declining constraint

Model 4:

Total allowable cut for the planning horizon: 220.898 million m^3
Average AAC per period : 14.727 million m^3
1st period cut : 9.518 million m^3
2nd - 3rd period cut : 15,099 million m^3

Ave. cut increased per period: 1.02 %
1st period cut increase: -7.23 %
2nd period cut increase: 18.50 %
3rd period cut increase: 16.16 %

Model 8:

	W.C. 1	W.C. 2	W.C. 3	W.C. 4	W.C. 5
Total	49.505	33.910	44.514	44.080	46.659
Ave. AAC	3.300	2.261	2.968	2.939	3.111
1st period cut			1.743	1.431	1.525
2nd period cut			2.617	2.980	1.584
3rd period cut			2.873	2.980	1.584

Total allowable cut for the planning horizon: 218.668 million m^3
Average AAC per period : 14.579 million m^3

Thus, the 8.89% increase here is not realistic and overestimates the increase by about 6.76 to 7.56% (8.89-2.13% or 8.89-1.33%). The 1.33 % to 2.13 % increase demonstrated earlier is a more probable figure for the effect of working circle boundaries.

Given a non-declining yield harvest policy, these effects disappear because of the gradual increases of the allowable cuts at later periods. The average difference for the planning horizon is an increase of only 1.02%. However, the difference is -7.23% in period 1, 18.50% in period 2 and 16.16% in period 3.

6.3 The Effect of Compartment Boundaries on Allowable Cut with no Access Constraints

6.3.1 At the Level of Whole Forest Area

The impact of compartment boundaries without working circles on the allowable cut can be examined by comparing Models 1 and 3, where Model 1 consists of stand based units and Model 3 consists of compartment based management units. The results are summarized in Table 6.3-1. The comparison shows a 1.31% increase in the allowable cut when the compartment boundaries are removed at the level of the whole forest area.

Table 6.3-1.

The effect of compartment boundaries on AAC(10^6 m^3) with no access constraints or working circles

Even-flow policy

Model 1 (No compartment boundaries):	
Total allowable cut for the planning horizon:	229.311 million m^3
AAC per period:	15.287 million m^3
Cut increased per period:	1.31 %
Model 3 (Compartment boundaries):	
Total allowable cut for the planning horizon:	226.345 million m^3
AAC per period:	15.090 million m^3

6.3.2 At the Level of Working Circles

The impact of compartment boundaries within working circles on the level of timber harvesting can be analyzed by comparing Models 5 and 7, where Model 5 is composed of stand based management units and Model 7 of compartment based management units. The summarized results are shown in Table 6.3-2. There is a 2.10% increase of the total allowable cut per period when the compartment boundaries are removed. This result, compared to the previous analysis at the level of the whole forest area, gives a slightly higher average increase because of a probable interaction effect of working circles on the compartment boundary analysis. Comparisons of individual working circles indicates that the 2.10% increase overall is not uniform by working circle. Individual working circle increases vary from 0.65% to 3.37%. It appears that compartment boundaries are less important in working circles 4 and 5 and more important in working circles 1 to 3.

Table 6.3-2.

The effect of compartment boundaries on AAC(10^6 m^3)
with no access constraints
using working circles

Even-flow constraint

Model 5 (No compartment boundaries, no access constraints):

	W.C. 1	W.C. 2	W.C. 3	W.C. 4	W.C. 5
Total	51.548	35.407	45.194	45.047	49.091
AAC	3.437	2.360	3.013	3.003	3.273
% Cut Increase	3.37	3.28	2.34	1.11	0.65

Total allowable cut
for the planning horizon: 226.287 million m^3
Total AAC per period : 15.086 million m^3

Ave. cut increased per period: 2.10 %

Model 7 (Compartment boundaries, no access constraints):

	W.C. 1	W.C. 2	W.C. 3	W.C. 4	W.C. 5
Total	49.876	34.269	44.156	44.546	48.774
AAC	3.325	2.285	2.944	2.970	3.252

Total allowable cut
for the planning horizon: 221.621 million m^3
Total AAC per period : 14.776 million m^3

6.4 The Effect of Access Constraints on Allowable Cut with no Working Circle Boundaries

The impact of access constraints on allowable cut without working circle boundaries is analyzed by examining Models 3 and 4, where Model 3 has no access restrictions and Model 4 does. The summary of the results is presented in Table 6.4-1.

These models, with an even-flow harvest policy, show a 15.46% difference which indicates that there is a significant relationship of access limits with the timber cutting level. It implies a large potential increase in the allowable cut when the access constraints are removed. Upon examination of the Model 4 runs, one finds that the large differences due to access constraints are caused by; (a) cuts in early periods being limited due to access concerns and (b) cuts in later periods being limited by the even-flow harvest policy in that they can not be larger than the early period harvests. This leads to a situation where not all of the FMA is used in Model 4. A possible solution to this would be to look at Models 3 and 4 using a non-declining yield constraint.

Model 3, using a non-declining yield constraint produces a solution which is the same as the even-flow version above and gives a 2.46% increase in the allowable cut, compared with Model 4 with access constraints and non-declining yield constraints. However, this Model 4, non-declining yield run, is probably not acceptable from the manager's point of view because of the severe reduction of the allowable cut in the first period of Model 4 to only 9.518 million m^3.

Table 6.4-1.

The effect of access constraints on AAC(10^6 m^3) with no working circle boundaries

Even-flow constraint

Model 3 (No access constraints, compartment boundaries):	
Total allowable cut for the planning horizon:	226.345 million m^3
AAC per period :	15.090 million m^3
Cut increased per period:	15.46 %
Model 4 (Access constraints, compartment boundaries):	
Total allowable cut for the planning horizon:	196.031 million m^3
AAC per period :	13.069 million m^3

Non-declining constraint

Model 3:	
Total allowable cut for the planning horizon:	226.345 million m^3
AAC per period :	15.090 million m^3
Ave. cut increased per period:	2.46 %
1st period cut increase :	58.54 %
Model 4:	
Total allowable cut for the planning horizon:	220.898 million m^3
Average AAC per period :	14.727 million m^3
1st period cut :	9.518 million m^3

6.5 The Effect of Access Constraints on Allowable Cut using Working Circle Boundaries

The results from Models 7 and 8 allow analysis of the impact of access constraints on allowable cut, with working circle boundaries. The summarized results are in Table 6.5-1.

The total 23.11% difference in the levels of optimal timber harvesting between the models with access limits and the ones without access restrictions, given an even-flow harvest policy, indicates that there is a strong significant relationship of the access limits with the allowable cut.

However, in the discussion in Section 6.2 above, it was noted that the runs for Model 8 for working circles 3, 4, and 5 have major reductions for the whole planning horizon due to unrealistic access concerns. In that case, the overall reduction was overestimated to be about 6.76% to 7.56%. It is interesting to note that, if the 23.11% estimated increase in this case is reduced by these amounts, the resulting 15.55 to 16.35% is very close to the 15.46% increase estimated in section 6.4. Thus, it appears that access constraints are causing a real reduction in allowable cut of about 15 to 16%, given an even-flow harvest policy.

The models, with non-declining constraints, show only 2.53% difference between the average volume outputs. However,

Table 6.5-1.
The effect of access constraints on AAC(10^6 m^3) using working circle boundaries

Even-flow constraint

Model 7 (No access constraints, compartment boundaries):

	W.C. 1	W.C. 2	W.C. 3	W.C. 4	W.C.5
Total	49.876	34.269	44.156	44.546	48.774
AAC	3.325	2.285	2.944	2.970	3.252
% Cut Increase	0.76	1.06	36.61	22.78	74.18

Total allowable cut for the planning horizon: 221.621 million m^3

Total AAC per period : 14.776 million m^3

Ave. cut increased per period: 23.11 %

Model 8 (Access constraints, compartment boundaries):

	W.C. 1	W.C. 2	W.C. 3	W.C. 4	W.C. 5
Total	49.505	33.910	32.332	36.280	28.011
AAC	3.300	2.261	2.155	2.419	1.867

Total allowable cut for the planning horizon: 180.038 million m^3

Total AAC per period : 12.002 million m^3

Non-declining constraint

Model 7:

	W.C. 1	W.C. 2	W.C. 3	W.C. 4	W.C. 5
Total	49.876	34.269	45.846	44.546	49.679
Ave. AAC	3.325	2.285	3.056	2.970	3.312
1st to 3rd period cut			2.944		3.252

Total allowable cut for the planning horizon: 224.216 million m^3

Average AAC per period : 14.948 million m^3

Ave. cut increased per period: 2.53 %

1st period cut increase : 43.84 %

2nd period cut increase : 15.82 %

3rd period cut increase : 13.54 %

Model 8:

	W.C. 1	W.C. 2	W.C. 3	W.C. 4	W.C. 5
Total	49.505	33.910	44.514	44.080	46.659
Ave. AAC	3.300	2.261	2.968	2.939	3.111
1st period cut			1.743	1.431	1.525
2nd period cut			2.617	2.980	1.584
3rd period cut			2.873	2.980	1.584

Total allowable cut for the planning horizon: 218.668 million m^3

Average AAC per period : 14.579 million m^3

the result is probably not acceptable to Weldwood because of the severe reductions of the timber volume cuts during the first to third periods with working circles 3, 4, and 5 in model group 8 because of access constraints.

6.6 Model size, Data Aggregation, Computing Relationships of the Various Models

From Tables 5.5-1 and 5.5-2, it is clear for this study that compartment based models (3, 4, 7, and 8) have fewer timber classes and fewer yield tables needed than models (1, 2, 5, and 6) that are stand based. Timber yield tables are more easily produced for the stand based models whereas economic yield tables are more easily produced for the compartment based models.

However, the differences between the two types of models in this study are really significant when one examines the matrix size of equivalent linear programs to determine optimal AAC's. Table 6.6-1 gives the matrix size of five Model 5 formulations and five Model 7 formulations. When these two models are used to examine the effects of compartment boundaries, for working circle one, the matrix is 355 rows by 17,682 columns or 6,277,110 cells for Model 5 while, for Model 7, the same working circle matrix is 82 rows by 1,948 columns or 159,736 cells. This means that Model 5 is 39 times the size of Model 7 for working circle 1. Thus, the models using stand based management units which require many more constraints (rows) and many more decision variables (columns) will require a large computer capacity and be more expensive to solve. The LP matrix size for Model 1 with economic factors and Models 2 and 6 were too large for the solution code on the computer to produce solutions. As well, each of the 15 Model 5 solutions cost an average of $300 to $500 to obtain, while 25 Model 7 solutions varied from $9 to $29 each. However, as demonstrated in the section 6.10, the increased cost for analysis in this case study is on the order of one cent or less per cubic meter of the allowable cut and thus is probably not significant in the decision to use compartment based or stand based units. It is clear that it is easier for the analyst to use compartment based analyses when economic constraints and access concerns are part of the problem, but in the case study, this ease came at a cost of potential loss in allowable cut of 1.31 - 2.10 percent.

Table 6.6-1.
The differences of the problem sizes between two forest land classification methods within working circles

Land classes Working circles	Model 5 Stand based		Model 7 Compartment based	
	Rows	Columns	Rows	Columns
W. C. 1	355	17682	82	1948
W. C. 2	309	14378	74	1575
W. C. 3	358	18231	65	1195
W. C. 4	436	23832	75	1813
W. C. 5	320	15995	82	2058

6.7 The Effect of Maximum Cost per Period Constraints on Working Circle Boundary Analysis

By summing the 5 working circles in Model 7 to compare with Model 3, the results in Section 6.1 showed that there was a 2.13% increase due to removing working circle boundaries with no cost constraints. Table 6.7-1 indicates clearly that, as maximum cost constraints per period are imposed, the percentage increase in cut due to removal of working circles is reduced. Thus these constraints tend to reduce or eliminate possible gains from removal of working circle boundaries.

Table 6.7-1.

The percentage differences in the AACs of Models 3 and 7 with cost constraints[1]

Max. Ave. Cost Const.	Model 7 (Sum)		Model 3		% Increase in AAC
	AAC M m3/per.	Total Ave. Cost M $/Per.	AAC M m3/per.	Total Ave. Cost M $/per.	
345	14.776	307.816	15.090	314.747	2.13
305	14.460	299.205	14.635	301.196	1.21
291	14.054	288.653	14.228	290.715	1.24
262	12.954	262.000	13.073	262.000	0.92

[1] M in this table and hereafter denotes 10^6

6.8 The Effect of Maximum Cost per Period Constraints on Compartment Boundary Analysis

Unconstrained analysis gave an increase of 2.10 percent for the whole forest when considering compartment boundaries (Section 6.3, Table 6.3-2). When cost constraints per period are imposed, the differences between Models 5 and 7, in general, get larger (Table 6.8-1). Overall with costs constrained to 345 million dollars per period which constitutes no constraint, because costs never reach that level, elimination of compartment boundaries gives an increase in AAC of 2.10%. If costs are constrained to 305 or 262 million dollars per period, then compartment boundary removals at those levels give increases in AAC of 2.34% and 2.48%, respectively (Table 6.8-1). Analysis by each working circle indicates working circles 3, 4, and 5 tend to follow this increasing trend where as working circles 1 and 2 display distinctly opposite trends.

Table 6.8-2 presents an interesting view, if one examines the average cost per cubic meter figures using Model 7 in working circle 1, we get 3.210 million cubic meters for $19.27 per cubic meter. Using Model 5 in working circle 1 at $19.27 per cubic meter, we produce 3.437 million cubic meters. This represents a gain in yield of 227,000 cubic meters per period at the same cost per cubic meter, or a 7.07% increase in yield per period at the same cost per cubic meter without

Table 6.8-1.

The percentage differences in the AACs of model group 5 and 7 with cost constraints[1]

	Max. Cost Const. (M $ /Per.)	Model 7	Model 5	% Increase in AAC
		AAC (M m3/Per.)	AAC (M m3/Per.)	
W.C.1	70	3.325	3.437	3.37
	65	3.268	3.352	2.57
	63	3.210		
	61	3.150		
	55	2.922	2.987	2.22
W.C.2	60	2.285	2.360	3.28
	50	2.260	2.315	2.43
	48	2.211		
	46	2.150		
	40	1.936	1.970	1.76
W.C.3	70	2.944	3.013	2.34
	63	2.888	2.955	2.32
	62	2.860		
	61	2.829		
	56	2.622	2.706	3.20
W.C.4	70	2.970	3.003	1.11
	60	2.946	2.983	1.26
	59	2.923		
	58	2.897		
	52	2.678	2.720	1.57
W.C.5	75	3.252	3.273	0.65
	67	3.098	3.194	3.10
	66	3.063		
	65	3.028		
	59	2.796	2.892	3.43
Whole forest	345	14.776	15.086	2.10
	305	14.460	14.799	2.34
	262	12.954	13.275	2.48

[1] The level of cost constraints used in each working circle was set at a value approximately equal to the average per period cost of the previous run. The upper limit in each working circle is nonconstraining in any period.

Table 6.8-2.

The AACs and the estimated 15 period average costs in model groups 5 and 7

	Max. Cost Const. per Per.	Model 7			Model 5		
		AAC (M m3 /per.	Total average (M $ /per.)	Ave. cost ($/m3)	AAC (M m3 /per.)	Total average (M $ /per.)	Ave. cost ($/m3)
W.C.1	70	3.325	64.988	19.54	3.437	66.219	19.27
	65	3.268	63.290	19.37	3.352	63.734	19.01
	63	3.210	61.845	19.27			
	61	3.150	60.355	19.16			
	55	2.922	55.000	18.82	2.987	55.000	18.41
W.C.2	60	2.285	48.650	21.29	2.360	50.299	21.31
	50	2.260	48.063	21.26	2.315	48.903	21.22
	48	2.211	46.695	21.12			
	46	2.150	45.146	20.99			
	40	1.936	40.000	20.66	1.970	40.000	20.31
W.C.3	70	2.944	64.214	21.81	3.013	64.257	21.33
	63	2.888	62.594	21.67	2.955	62.220	21.05
	62	2.860	61.887	21.64			
	61	2.829	61.000	21.56			
	56	2.622	56.000	21.36	2.706	56.000	20.69
W.C.4	70	2.970	59.717	20.11	3.003	59.737	19.89
	60	2.946	59.043	20.04	2.983	58.964	19.76
	59	2.923	58.331	19.95			
	58	2.897	57.580	19.86			
	52	2.678	52.000	19.42	2.720	52.000	19.12
W.C.5	75	3.252	70.247	21.60	3.273	68.922	21.06
	67	3.098	66.215	21.37	3.194	66.346	20.77
	66	3.063	65.411	21.35			
	65	3.028	64.572	21.33			
	59	2.796	59.000	21.10	2.892	59.000	20.40

compartment boundaries.

However, this comparison is not very useful to an operational manager because it uses the average cost per period (decade) over 15 periods. Of more interest to an operational manager would be the cost in the first period (10 years). Models (5 and 7) place an upper limit on cost in any period, thus the manager would make decisions primarily based upon the first period costs knowing that the remaining periods are reasonable. Table 6.8-3 is developed using the first period average cost data. Unlike Table 6.8-2, the average costs in Table 6.8-3 are not, in general, "well behaved". For example, in working circle 2, if costs per period are constrained at 60 million dollars per period (which is unconstraining because no period costs that much), Model 7 gives an AAC of 2.285 million cubic meters per period with a first period total cost of 48.223 million dollars and an average cost of $21.10 per cubic meter. However, when cost per period is limited to 50 million dollars, cut drops to 2.260 million cubic meters per period with a total cost in the first period of 48.679 million dollars and an average cost of $21.54 per cubic meter. Thus, less is cut at more total cost and a higher cost per cubic meter. The reason for this is that the volume of harvest was maximized over fifteen, ten-year periods in a manner that costs in no decade exceeded 60 or 50 million dollars, respectively. With the 60 million constraint, no

Table 6.8-3.

The AACs and the first period average costs in model groups 5 and 7

	Max. Cost Const. per Per.	Model 7			Model 5		
		AAC (M m3)	1st per. Cost (M $)	Ave. Cost ($/m3)	AAC (M m3)	1st per. Cost (M $)	Ave. Cost ($/m3)
W.C. 1	70	3.325	64.535	19.41	3.437	63.213	18.39
	65	3.268	62.954	19.26	3.352	62.050	18.51
	63	3.210	61.893	19.28			
	61	3.150	60.552	19.22			
	55	2.922	55.000	18.82	2.987	55.000	18.41
W.C. 2	60	2.285	48.223	21.10	2.360	50.119	21.24
	50	2.260	48.679	21.54	2.315	48.977	21.16
	48	2.211	46.277	20.93			
	46	2.150	44.871	20.87			
	40	1.936	40.000	20.66	1.970	40.000	20.30
W.C. 3	70	2.944	62.137	21.11	3.013	60.072	19.94
	63	2.888	62.372	21.60	2.955	61.731	20.89
	62	2.860	61.858	21.63			
	61	2.829	61.000	21.56			
	56	2.622	56.000	21.34	2.706	56.000	20.69
W.C. 4	70	2.970	59.311	19.97	3.003	54.478	18.14
	60	2.946	58.092	19.72	2.983	54.886	18.40
	59	2.923	56.981	19.49			
	58	2.897	55.648	19.21			
	52	2.678	52.000	19.42	2.720	52.000	19.12
W.C. 5	75	3.252	71.415	21.96	3.273	70.374	21.50
	67	3.098	67.000	21.63	3.194	67.000	20.98
	66	3.063	66.000	21.55			
	65	3.028	65.000	21.47			
	59	2.796	59.000	21.10	2.892	59.000	20.40

decade's cost reached that level, but several were over 50 million dollars. When cut was maximized with a 50 million dollar per period limit, expensive potential harvest from the future was transferred to the first period to reduce future costs down to the limit and use up unused constraint dollars in the first period. In the other case, the equivalent harvest in the first several periods was achieved without reaching the cost constrained level. This kind of anomaly is also shown with working circle 3 in Model 7 and working circles 3 and 4 in Model 5. These same trends produce all kinds of anomalies in the average cost per cubic meter figures. Theoretically, total cost in the first period and average costs should go up with each increase in the allowable cut, but this occurs only if one optimizes or selects cuts based on cost. In the case study, cuts were selected to maximize volume harvested with an even-flow inter-period volume constraint subject to a maximum total cost constraint per period. Thus, if the even-flow harvest constraint is critical, or if total cost of harvest in period 13, for example, is critical, the first period costs may not "behave normally".

While the results of changing from compartment based units to stand based units shown in either Table 6.8-2 or 6.8-3 favour the stand based units (no compartment boundaries), one must note that specific moving and set up costs for forest equipment are included only at the average value for Alberta.

In general, companies in Alberta have logged using a compartment based aggregation; thus this average cost for set up and moving of logging equipment reflects compartment based aggregation. In this study, the number of the proposed logging areas for the first planning period using compartment based analysis were 3 to 12 compartments which is much smaller than the 34 to 77 stands used in stand based analyses. Even though stands will be aggregated for logging, it is unlikely that this aggregation will reduce the number of separate areas to be logged per period to that of a compartment based aggregation. In the analysis of Models 5 and 7, the increased cost of this function for Model 5 are not reflected in these analyses.

6.9 The Effect of Maximum Cost per Period Constraints on Access Constraint Analysis

Analysis of the effects of maximum cost constraints per period on Models 3 and 4 used to demonstrate access constraints is difficult. Table 6.9-1 shows the effects of cost constraints on each model. However, Model 4 is so constrained by management access concerns and a policy of even-flow that the cost per period constraints used in Model 3 hardly overlap those of Model 4. Due to the lack of significant overlap of harvest levels and cost constraint levels, marginal cost analysis is not attempted for this model comparison. With these constraints, the allowable cut is dramatically restricted to, at most, the cut level of 13.069 million m^3 per period with the 15 period average total cost of 274.11 million dollars per period as compared with the maximum cut level of 15.090 million m^3 per period and a 15 period average total cost of 314.747 million dollars per period without access limits. It is also worthwhile to note that the most constrained harvest of 13.073 million m^3 per period was achieved in Model 3 with no access constraints and a cost constraint per period and an average total cost per period of $262 million. Model 4 with an unconstrained cost constraint per period, however, never reached that level of harvest due to the access constraints and even-flow policy.

The above results reveal that there is a large potential to increase the allowable cut by adjusting either the current forest road access schedule or the even-flow policy for timber production. However, since the adjustment of the flow policy (section 6.4) did not seem to produce acceptable solutions (very low 1st period harvests), modification of access limitations appears to be a logical way to get potentially large increases in the allowable cut.

Table 6.9-1.

The AACs and the costs in Models 3 and 4 with constraints on maximum per period cost[1]

	Max. cost const. (M $ /per.)	AAC (M m3 /per.)	15 per. average total cost (M m3/per.)	15 per. average cost ($/m3)
MODEL 3	345	15.090	314.747	20.86
	305	14.635	301.196	20.58
	291	14.228	290.715	20.43
	262	13.073	262.000	20.04
	0	0	0	0
MODEL 4	290	13.069	274.11	20.97
	275	13.067	273.12	20.90
	270	13.019	269.35	20.69
	262	12.676	261.75	20.65
	0	0	0	0

6.10 Marginal Cost of Allowable Cut

To get a marginal cost of allowable cut curve, the wood supply available on each working circle was examined starting with a maximum cost of 0 and an allowable cut of 0. Using the output from the cost constrained runs of Models 5 and 7 shown in Table 6.8-3, a AAC from 0 to the maximum for each working circle was developed. Any and all intermediate outputs which gave an increasing average marginal cost, are displayed in Table 6.10-1. For example, with working circle 4, Model 5

Table 6.10-1.

The AACs and the first period average marginal costs for model groups 5 and 7

	Max. Cost Const. per Per.	Model 7			Model 5		
		AAC (M m3)	1st per. Cost (M $)	Ave. Mar. Cost ($/m3)	AAC (M m3)	1st per. Cost (M $)	Ave. Mar. Cost ($/m3)
W.C. 1	70	3.325	64.535	27.74	3.437	63.213	18.39
	65	3.268	62.954	22.99			
	55	2.922	55.000	18.82			
	0	0.000	0.000		0.000	0.000	
W.C. 2	60	2.285	48.223	26.30	2.360	50.119	25.95
	48	2.211	46.277	23.05			
	46	2.150	44.871	22.76			
	40	1.936	40.000	20.66	1.970	40.000	20.30
	0	0.000	0.000		0.000	0.000	
W.C. 3	70	2.944	62.137	33.21	3.013	60.072	19.94
	62	2.860	61.858	27.68			
	61	2.829	61.000	24.15			
	56	2.622	56.000	21.36			
	0	0.000	0.000		0.000	0.000	
W.C. 4	70	2.970	59.311	49.57	3.003	54.478	18.14
	59	2.923	56.981	20.33			
	52	2.678	52.000	19.42			
	0	0.000	0.000		0.000	0.000	
W.C. 5	75	3.252	71.415	28.67	3.273	70.374	42.71
	67	3.098	67.000	28.57	3.194	67.000	26.49
	65	3.028	65.000	25.86			
	59	2.796	59.000	21.10	2.892	59.000	20.40
	0	0.000	0.000		0.000	0.000	

produced only one marginal cost entry going from 0 production to 3.003 million cubic meters AAC at an average marginal cost of $18.14 per cubic meter (all other marginal costs between 0 and any other production output value produce marginal costs greater than $18.14). Whereas Model 7 analysis for this same working circle produced three average marginal cost entries. Going from 0 to 2.678 million cubic meters is achieved at an average marginal cost of $19.42 per cubic meter, going from 2.678 to 2.923 million cubic meters is achieved at an average marginal cost of $20.33 per cubic meter and going from 2.923 to 2.970 million cubic meters is achieved at an average marginal cost of $49.57 per cubic meter.

If the FMA is harvested by a rule which harvests least costly stands first, the data in Table 6.10-1 can be used to produce a marginal cost of allowable cut curve for both Model 5 and Model 7. Table 6.10-2 and Figure 6.10-1, respectively, represent a tabular representation and pictorial view of these supply curves.

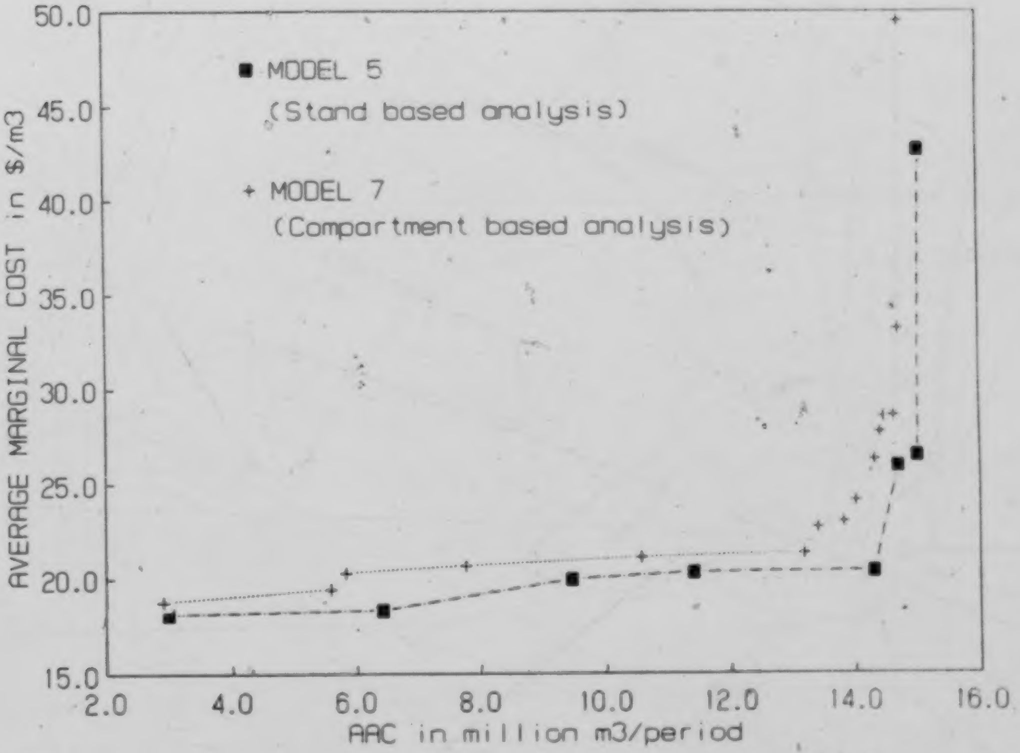
These curves can be used in two major ways; once a curve is selected for use by the company (Model 5 or 7), then that curve can be used as a guide for maximum unit cost for wood quantities purchased from off the lease. For example, at any production level (AAC), one can determine the average marginal cost of this timber supply and thus one would be willing to

Table 6.10-2.

The 1st period average marginal cost of allowable cut for Models 5 and 7

Model 5			Model 7		
AAC (M m3)	Marginal increase in AAC (M m3)	Average marginal costs ($/m3)	AAC (M m3)	Marginal increase in AAC (M m3)	Average marginal costs ($/m3)
3.003		18.14	2.922		18.82
6.440	3.437	18.39	5.600	2.678	19.42
9.453	3.013	19.94	5.845	0.245	20.33
11.423	1.970	20.30	7.781	1.936	20.66
14.315	2.892	20.40	10.577	2.796	21.10
14.705	0.390	25.95	13.199	2.622	21.36
15.007	0.302	26.49	13.413	0.214	22.76
15.086	0.079	42.71	13.759	0.346	22.90
			13.820	0.061	23.05
			14.027	0.207	24.15
			14.259	0.232	25.86
			14.333	0.074	26.30
			14.364	0.031	27.68
			14.421	0.057	27.74
			14.491	0.070	28.57
			14.645	0.154	28.67
			14.729	0.084	33.21
			14.776	0.047	49.57

Figure. 6.10-1 The 1st Period AAC Supply Curves
for Models 5 and 7



purchase wood at any cost less than this cost. Large potential purchases would affect the level of the average marginal cost of allowable cut and thus you would have to look at the new average marginal cost of the reduced AAC harvested to ensure that you were not paying too much for the external purchase.

The second way these curves can be used is as an aid to the decision maker to select which Model, 5 or 7, to use. From Figure 6.10-1, it is clear that Model 7 costs more per cubic meter to produce equivalent outputs, however, Model 5 analyses are more expensive to produce. As well, as indicated above, the cost per cubic meter in Model 5 analyses is underestimated by the lack of an additional cost to reflect probable increased costs due to increased equipment movement and set-up costs for stand level management (Model 5) compared to area level management (Model 7). Thus, a manager, to make a valid comparison, would have to increase the cost per cubic meter for Model 5 for analysis expense and for the increased equipment movement cost per cubic meter. Since the analysis expense would be an increased fixed cost, it would increase an average marginal cost per m^3 in a decreasing amount as AAC increases. For example, assuming replanning at every period and increased analysis cost were \$50,000, marginal cost would increase \$0.005/m^3 at an AAC of 10 million cubic meters per period, but only \$0.0033/m^3 at an AAC of 15 million cubic meters per period. Since these costs for more costly analyses give rise to an increase of less than one cent per cubic meter of harvest, they are probably insignificant.

The increase in cost due to increased equipment movement and set up charges is more likely to be expressed by the company in terms of a fixed additional charge per cubic meter logged and thus would result in an equal shift upward of the supply curve. The magnitude of this shift would be critical to the manager to decide whether stand or area based analysis were the best.

7. Conclusions

7.1 Case Study Results

This study shows that increases in allowable cuts ranging from 1.33% to 2.13% are possible by elimination of working circle boundaries for even-flow harvest schedule strategies. With non-declining yield harvest schedule strategies, the increases average 0.95% over the 150 year planning horizon with increases of 2.13% over the first 110 years of the planning horizon.

The effect of changing from compartment based management units to stand based management units is examined by removing compartment boundaries. The different comparisons, using an even-flow policy, result in increases in allowable cuts of 1.31% to 2.10%. When working circle boundaries are ignored, the increase was a 1.31%. When working circle boundaries are included, the overall increase is a 2.10%. In this latter example, results differed by working circle with increases from 0.65% to 3.37%. It appears compartment boundaries are less important in working circles 4 and 5 and more important in working circles 1 to 3.

Removal of access constraints, as interpreted in this study, appears to lead to a 15 - 16% increase in allowable cut for cases where an even-flow policy is used. However, the above results should be examined carefully since the access relationship used here was an interpretation of the 5-year planning period constraints currently used by the company which were translated to the 10-year periods used in this study. Some of these access constraints may be operational priorities rather than real road problems and thus the potential increase shown may be too large.

Results of runs in Model 8, working circle 3, 4, and 5, clearly demonstrate, if LP is used with an even-flow requirement, that early access constraints that are severe will lead to unrealistic results. Clearly, if access is as limited early, as was modeled, one would either modify the even-flow requirement to allow an increase in cut as access improved or one would remove some of the early access problems by a more aggressive road building program.

Using a non-declining yield flow policy, increases due to removal of access constraints average 2.53% to 2.46% for the planning horizon. However, these results are probably not acceptable from the manager's point of view because of the severe reduction of the allowable cut in the first period to only 9.518 to 10.260 million m^3.

Placing a constraint on maximum cost per planning period has different effects on each of the analyses above. The effect of removing working circle boundaries tends to diminish as cost constraints become more severe. Thus, the 2.13% increase reported earlier is reduced as costs became constraining.

In the stand based versus compartment based analysis (compartment boundary analysis), the effect of increasing cost constraints on this analysis tends overall to increase the percentage effect of removal of boundaries. Thus, the 2.10% increase reported earlier is increased as costs become constraining. However, the result is not uniform by individual working circles, ranging from 0.65% to 3.37%. By incrementally examining increases in AAC generated on the working circles at different cost constraints, an average marginal cost of allowable cut curve was developed for each type of analysis (stand and compartment based). Careful use of this curve will permit Weldwood managers to select the least costly method of analysis for any particular desired allowable cut. As well the selected curve can aid Weldwood managers to set upper limits on off lease wood purchase prices.

7.2 General Study Results

The results of this study support those of Jamnick et *al.* (1990) that stand based land unit classifications give higher objective values than compartment based land unit classifications, but these large values are percentage wise not very much larger. To get them, increased costs are incurred in the planning model formulation and solution. As well, logging cost to move and set up equipment more frequently would be increased using stand based operations compared to compartment based operations for forest with larger number of stand types than that of compartments.

If maximum cost constraints per period and access considerations are desirable in the planning model, then it is easier to use compartment based management units for the analysis since the locational data for economic analysis and access concerns can be easily obtained. As well, significant reductions in model sizes and costs for solutions are achieved this way, but at a loss of a gain in allowable cut possible by using stand based forest units.

Finally, when cost constraints per period are used, the method of developing marginal cost of supply curves from section 5.7.1 can be adopted by others to develop timber supply curves which permit managers to select which type of land classification is best or most appropriate for their particular planning problem.

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9. Appendix I - Stand based timber yield data

```
60 timber yield streams

   First rows    the identity and description of yield stream
   Second rows   the timber volume (m3/ha) of yield stream
                 in 10 years age classes from 1 to 15 decades

   Species    Lodgepole pine     1 - 39 yield streams
              White spruce      40 - 50 yield streams
              Black spruce      51 - 54 yield streams
              Alpine fir             55 yield stream
              Mixed             56 - 60 yield streams

   Site Index = Height in feet at reference age 50 years

   Density (percent crown closure class)
                                                    A =  6 -  30
                                                    B = 30 -  50
                                                    C = 50 -  70
                                                    D = 70 - 100

 1     Potentially productive, lodgepole pine, all density classes
 0   0   0   0   0   0   0   0   0   0   0   1   8  14  20

 2     Site Index 25, lodgepole pine, all density classes
 0   0   0   0   0   0   0   0  11  24  37  50  63  75  87

 3     Site Index 30, lodgepole pine, density classes of B, C and D
 0   0   0   0   0   0   9  26  44  62  79  97 113 129 143

 4     Site Index 35, lodgepole pine, density class B
 0   0   0   0  18  38  61  81 100 117 132 148 158 168 178

 5     Site Index 35, lodgepole pine, density class C
 0   0   0   0   0  13  35  58  82 108 128 148 167 184 200

 6     Site Index 35, lodgepole pine, density class D
 0   0   0   0   0   0   8  40  71 100 128 153 175 195 213

 7     Site Index 40, lodgepole pine, density class B
 0   0   0   6  35  63  88 111 132 150 165 179 191 201 211

 8     Site Index 40, lodgepole pine, density class C
 0   0   0   0   9  38  68  98 126 155 180 202 221 238 253

 9     Site Index 40, lodgepole pine, density class D
 0   0   0   0   0  11  52  91 128 160 188 215 238 255 271

10     Site Index 30 - 50, lodgepole pine, density class A
 0   4  10  20  33  48  66  84 102 119 135 149 162 173 184

11     Site Index 45, lodgepole pine, density class B
 0   0   0  22  56  88 117 142 163 181 197 210 221 231 239

12     Site Index 45, lodgepole pine, density class C
 0   0   0   0  31  68 106 143 176 205 231 252 271 288 300

13     Site Index 45, lodgepole pine, density class D
 0   0   0   0   2  52 101 146 185 219 247 270 289 306 318
```

```
14     Site Index 50, lodgepole pine, density class B
 0   0   0  39  79 116 146 172 193 211 226 236 249 258 264

15     Site Index 50, lodgepole pine, density class C
 0   0   0  14  57 104 149 189 224 254 278 297 313 327 338

16     Site Index 50, lodgepole pine, density class D
 0   0   0   0  37  97 153 201 240 271 296 316 331 344 354

17     Potentially productive, lodgepole pine and other softwoods, all density classes
 0   0   0   0   0   0   0   0   0   0   1   8  16  23  31

18     Site Index 25, lodgepole pine and other softwoods, density classes of B, C and D
 0   0   0   0   0   0   0   0   0   2  19  36  50  64  77

19     Site Index 25 - 30, lodgepole pine and other softwoods, density class A
 0   0   0   0   5  13  21  29  38  46  54  62  70  77  84

20     Site Index 30, lodgepole pine and other softwoods, density classes of B, C and D
 0   0   0   0   0   0   6  21  36  52  67  82  97 111 124

21     Site Index 35 - 40, lodgepole pine and other softwoods, density class A
 0   0   0   3  12  23  34  45  56  67  77  86  95 103 112

22     Site Index 35, lodgepole pine and other softwoods, density classes of B, C and D
 0   0   0   0   0   9  29  50  70  90 110 128 147 164 180

23     Site Index 40, lodgepole pine and other softwoods, density class B
 0   0   0   8  27  47  68  88 108 127 144 160 176 189 203

24     Site Index 40, lodgepole pine and other softwoods, density class C
 0   0   0   0   0  30  58  89 119 147 171 193 213 231 247

25     Site Index 40, lodgepole pine and other softwoods, density class D
 0   0   0   0   7  31  57  84 110 135 160 182 203 223 241

26     Site Index 45, lodgepole pine and other softwoods, density class A
 0   0   1  15  32  49  67  84 100 114 128 139 150 159 168

27     Site Index 45, lodgepole pine and other softwoods, density class B
 0   0   0  18  42  68  94 118 142 163 183 201 217 231 244

28     Site Index 45, lodgepole pine and other softwoods, density class C
 0   0   0   0  11  58  97 135 168 197 223 246 266 283 299

29     Site Index 45, lodgepole pine and other softwoods, density class D
 0   0   0   0  25  57  91 124 156 186 214 239 263 283 302

30     Site Index 50, lodgepole pine and other softwoods, density class A
 0   0   6  23  44  65  86 106 125 140 154 166 177 188 196

31     Site Index 50, lodgepole pine and other softwoods, density class B
 0   0   2  30  60  92 123 152 178 202 223 241 257 272 284

32     Site Index 50, lodgepole pine and other softwoods, density class C
 0   0   0   0  43  94 141 181 216 247 273 296 316 333 347

33     Site Index 50, lodgepole pine and other softwoods, density class D
 0   0   0  10  48  88 129 170 207 241 271 298 322 344 362
```

```
34     Potentially productive, lodgepole pine and hardwoods, all density classes
 0   0   0   0   0   0   0   0   0   1   3   5   7   9  11

35     Site Index 25 - 40, lodgepole pine and hardwoods, density class A
 0   0   0   1   5  11  18  26  34  42  50  58  65  72  78

36     Site Index 25 - 40, lodgepole pine and hardwoods, density classes of B, C and D
 0   0   0   2   8  18  28  40  53  66  78  91 103 115 127

37     Site Index 45 - 50, lodgepole pine and hardwoods, density class A
 0   0   2  12  25  41  58  74  89 102 113 122 130 138 142

38     Site Index 45 - 50, lodgepole pine and hardwoods, density classes of B, C and D
 0   0   4  15  35  64  91 119 145 170 191 211 227 242 254

39     Site Index 55, lodgepole pine and hardwoods, density classes of C and D
 0   0   5  30  59  93 128 162 192 216 240 258 274 287 297

40     Potentially productive, white spruce, all density classes
 0   0   0   0   0   0   0   0   0   0   2   9  17  26  36

41     Site Index 20 - 50, white spruce, density class A
 0   0   0   0   4  14  24  33  41  49  56  62  68  73  78

42     Site Index 20 - 50, white spruce, density class B
 0   0   0   0   0  15  37  61  87 114 142 168 196 220 244

43     Site Index 20 - 50, white spruce, density classes C and D
 0   0   0   0   0   0   0  45  88 128 164 198 225 251 276

44     Potentially productive, white spruce and other softwoods, all density classes
 0   0   0   0   0   0   0   0   0   0   0   4  16  33  48

45     Site Index 20 - 50, white spruce and other softwoods, density class A
 0   0   0   1   7  15  27  41  58  78 101 124 148 171 193

46     Site Index 20 - 50, white spruce and other softwoods, density classes of B, C and D
 0   0   0   0  11  34  59  85 111 137 162 186 208 229 248

47     Site Index 60, white spruce and other softwoods, density class A
 0   0   4  20  47  84 129 176 220 257 288 312 330 344 355

48     Potentially productive, white spruce and hardwoods, all density classes
 0   0   0   1   2   3   3   4   5   7   9  12  14  18  22

49     Site Index 20 - 50, white spruce and hardwoods, all density classes
 0   1   3   6  12  20  32  48  70  96 125 157 189 222 253

50     Site Index 53, white spruce and hardwoods, density classes C and D
 0   2   5  12  25  46  77 118 162 210 257 300 339 373 401

51     Potentially productive, black spruce, all density classes
 0   0   0   0   0   0   1   2   3   4   5   7   8  12  15

52     Site Index 20 - 50, black spruce, all density classes
 0   0   0   0   0   3  14  25  37  50  63  77  90 102 115

53     Potentially productive, black spruce and other softwoods and hardwoods, all density classes
 0   0   0   0   0   0   0   1   4   8  12  17  22  27  32
```

```
54     Site Index 20 - 50, black spruce and other softwoods and hardwoods, all density classes
 0   0   0   0   0   4  27  49  70  89 108 124 140 154 166

55     Site Index 20 - 50, balsam (subalpine) fir and other softwoods and hardwoods, all density classes
 0   5  15  30  45  60  76  93 117 130 144 158 171 186 196

56     Potentially productive, hardwoods and softwoods, all density classes
 0   0   0   0   0   0   0   0   0   0   1   3   5   8  10

57     Site Index 25 - 50, hardwoods and softwoods, density class A
 0   0   0   5  13  21  28  35  41  46  50  54  57  59  61

58     Site Index 25 - 50, hardwoods and softwoods, density classes of B, C and D
 0   0   0   4  15  27  38  49  58  65  72  77  82  85  88

59     Site Index 53, hardwoods and softwoods, density classes of C and D
 0   0   0   7  19  32  45  56  65  73  79  84  88  91  93

60     Site Index 58, hardwoods and softwoods, density classes of A and B
 0   0  12  28  43  56  68  78  83  89  93  96  99 101 103
```

10. Appendix II - The average ages and yield estimates for compartment based management units of working circle 1

```
WORKING CIRCLE 1

First column.      the identity of each stand
Second column      the identity of each compartment
Third column       the area of each stand in hectares
Fourth column      the age of each stand
Fifth column       the yield stream identity for existing stand
Sixth to Eighteenth columns   the yield stream (m3/ha) for existing stand from 3 to 15 decades
Ninteenth column  the yield stream identity for regeneration stand
20th to 32th columns   the yield stream (m3/ha) for regeneration stand from 3 to 15 decades

The total area of compartment, average age, and yield estimates are below each compartment

   1  1   412   95  2   0   0   0   0   0   0  11  24  37  50  63  75  87 16   0   0  37  97 153 201 240 271 296 316 331 344 354
   2  1   412   95  2   0   0   0   0   0   0  11  24  37  50  63  75  87 16   0   0  37  97 153 201 240 271 296 316 331 344 354
   3  1   103  125  2   0   0   0   0   0   0  11  24  37  50  63  75  87 16   0   0  37  97 153 201 240 271 296 316 331 344 354
   4  1   103  125  2   0   0   0   0   0   0  11  24  37  50  63  75  87 16   0   0  37  97 153 201 240 271 296 316 331 344 354
   5  1   103  205  2   0   0   0   0   0   0  11  24  37  50  63  75  87 16   0   0  37  97 153 201 240 271 296 316 331 344 354
   6  1   103  205  2   0   0   0   0   0   0  11  24  37  50  63  75  87 16   0   0  37  97 153 201 240 271 296 316 331 344 354
   7  1   103   75  3   0   0   0   0   9  28  44  62  79  97 113 129 143 16   0   0  37  97 153 201 240 271 296 316 331 344 354
   8  1   103   75  3   0   0   0   0   9  28  44  62  79  97 113 129 143 16   0   0  37  97 153 201 240 271 296 316 331 344 354
   9  1   103  145  3   0   0   0   0   9  28  44  62  79  97 113 129 143 16   0   0  37  97 153 201 240 271 296 316 331 344 354
  10  1   103  145  3   0   0   0   0   9  28  44  62  79  97 113 129 143 16   0   0  37  97 153 201 240 271 296 316 331 344 354
  11  13090   95  5   0   0   0  13  35  59  83 106 128 148 167 184 200 16   0   0  37  97 153 201 240 271 296 316 331 344 354
  12  13090   95  5   0   0   0  13  35  59  83 106 128 148 167 184 200 16   0   0  37  97 153 201 240 271 296 316 331 344 354
  13  1   103  115  5   0   0   0  13  35  59  83 106 128 148 167 184 200 16   0   0  37  97 153 201 240 271 296 316 331 344 354
  14  1   103  115  5   0   0   0  13  35  59  83 106 128 148 167 184 200 16   0   0  37  97 153 201 240 271 296 316 331 344 354
  15  1   206  125  5   0   0   0  13  35  59  83 106 128 148 167 184 200 16   0   0  37  97 153 201 240 271 296 316 331 344 354
  16  1   206  125  5   0   0   0  13  35  59  83 106 128 148 167 184 200 16   0   0  37  97 153 201 240 271 296 316 331 344 354
  17  11030   95  6   0   0   0   0   8  40  71 100 128 153 175 195 213 16   0   0  37  97 153 201 240 271 296 316 331 344 354
  18  11030   95  6   0   0   0   0   8  40  71 100 128 153 175 195 213 16   0   0  37  97 153 201 240 271 296 316 331 344 354
  19  1   515   95 10  10  20  33  48  66  84 102 118 135 148 162 173 184 16   0   0  37  97 153 201 240 271 296 316 331 344 354
  20  1   515   95 10  10  20  33  48  66  84 102 118 135 148 162 173 184 16   0   0  37  97 153 201 240 271 296 316 331 344 354
  21  1   412   95 14   0  35  78 115 146 172 193 211 225 238 248 256 264 16   0   0  37  97 153 201 240 271 296 316 331 344 354
  22  1   412   95 14   0  35  78 115 146 172 193 211 225 238 248 256 264 16   0   0  37  97 153 201 240 271 296 316 331 344 354
  23  1   618   95 15   0  14  57 104 149 189 224 254 278 297 313 327 338 16   0   0  37  97 153 201 240 271 296 316 331 344 354
  24  1   618   95 15   0  14  57 104 149 189 224 254 278 297 313 327 338 16   0   0  37  97 153 201 240 271 296 316 331 344 354
  25  1   103   95 16   0   0  37  97 153 201 240 271 296 316 331 344 354 16   0   0  37  97 153 201 240 271 296 316 331 344 354
  26  1   103   95 16   0   0  37  97 153 201 240 271 296 316 331 344 354 16   0   0  37  97 153 201 240 271 296 316 331 344 354
  27  1   206   35 18   0   0   0   0   0   0   0   3  19  35  50  64  77 28   0   0  11  56  97 138 166 197 223 246 266 283 299
  28  1   206   35 18   0   0   0   0   0   0   0   3  19  35  50  64  77 28   0   0  11  56  97 138 166 197 223 246 266 283 299
  29  1   927   95 22   0   0   0   9  29  50  70  90 110 128 147 164 180 28   0   0  11  56  97 138 166 197 223 246 266 283 299
  30  1   927   95 22   0   0   0   9  29  50  70  90 110 128 147 164 180 28   0   0  11  56  97 138 166 197 223 246 266 283 299
  31  1   309  105 22   0   0   0   9  29  50  70  90 110 128 147 164 180 28   0   0  11  56  97 138 166 197 223 246 266 283 299
  32  1   309  105 22   0   0   0   9  29  50  70  90 110 128 147 164 180 28   0   0  11  56  97 138 166 197 223 246 266 283 299
  33  1   103  205 23   0   8  27  47  68  88 108 127 144 160 176 189 202 28   0   0  11  56  97 138 166 197 223 246 266 283 299
  34  1   103  205 23   0   8  27  47  68  88 108 127 144 160 176 189 202 28   0   0  11  56  97 138 166 197 223 246 266 283 299
  35  1   206  205 24   0   0   0  20  56  89 118 147 171 193 213 231 247 28   0   0  11  56  97 138 166 197 223 246 266 283 299
  36  1   206  205 24   0   0   0  20  56  89 118 147 171 193 213 231 247 28   0   0  11  56  97 138 166 197 223 246 266 283 299
  37  1   309   95 31   3  30  60  92 123 152 178 202 223 241 257 272 284 28   0   0  11  56  97 138 166 197 223 246 266 283 299
  38  1   309   95 31   3  30  60  92 123 152 178 202 223 241 257 272 284 28   0   0  11  56  97 138 166 197 223 246 266 283 299
  39  1   206  115 32   0   0  43  94 141 181 216 247 273 296 318 332 347 28   0   0  11  56  97 138 166 197 223 246 266 283 299
  40  1   206  115 32   0   0  43  94 141 181 216 247 273 296 318 332 347 28   0   0  11  56  97 138 166 197 223 246 266 283 299
  41  1   103   95 35   0   1   5  11  18  26  34  42  50  58  65  72  78 39   8  30  59  93 128 162 192 216 240 256 274 287 297
  42  1   103   95 35   0   1   5  11  18  26  34  42  50  58  65  72  78 39   8  30  59  93 128 162 192 216 240 256 274 287 297
  43  1   103   95 38   4  18  39  64  91 118 145 170 191 211 227 242 254 39   8  30  59  93 128 162 192 216 240 256 274 287 297
  44  1   103   95 38   4  18  39  64  91 118 145 170 191 211 227 242 254 39   8  30  59  93 128 162 192 216 240 256 274 287 297

  45  1   103  125 42   0   0   0  16  37  61  87 114 142 168 188 220 244 43   0   0   0   0   0  45  88 128 164 198 225 251 274
  46  1   103  125 42   0   0   0  16  37  61  87 114 142 168 188 220 244 43   0   0   0   0   0  45  88 128 164 198 225 251 274
  47  1   206  115 43   0   0   0   0   0  45  88 128 164 198 225 251 274 43   0   0   0   0   0  45  88 128 164 198 225 251 274
  48  1   206  115 43   0   0   0   0   0  45  88 128 164 198 225 251 274 43   0   0   0   0   0  45  88 128 164 198 225 251 274
  49  1   103  135 43   0   0   0   0   0  45  88 128 164 198 225 251 274 43   0   0   0   0   0  45  88 128 164 198 225 251 274
  50  1   103  135 43   0   0   0   0   0  45  88 128 164 198 225 251 274 43   0   0   0   0   0  45  88 128 164 198 225 251 274
  51  1   206   95 46   0   0  11  34  59  85 111 137 162 186 208 228 246 47   4  20  47  84 128 178 220 257 288 312 330 344 355
  52  1   206   95 46   0   0  11  34  59  85 111 137 162 186 208 228 246 47   4  20  47  84 128 178 220 257 288 312 330 344 355
  53  1   309  115 46   0   0  11  34  59  85 111 137 162 186 208 228 246 47   4  20  47  84 128 178 220 257 288 312 330 344 355
  54  1   309  115 46   0   0  11  34  59  85 111 137 162 186 208 228 246 47   4  20  47  84 128 178 220 257 288 312 330 344 355
  55  1   103  135 46   0   0  11  34  59  85 111 137 162 186 208 228 246 47   4  20  47  84 128 178 220 257 288 312 330 344 355
  56  1   103  135 46   0   0  11  34  59  85 111 137 162 186 208 228 246 47   4  20  47  84 128 178 220 257 288 312 330 344 355
  57  1   206  205 46   0   0  11  34  59  85 111 137 162 186 208 228 246 47   4  20  47  84 128 178 220 257 288 312 330 344 355
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  59  1   103   95 49   3   8  12  20  32  48  70  98 128 157 188 222 253 50   5  12  25  48  77 116 162 210 257 300 338 373 401
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  61  1   412  145 52   0   0   0   3  14  25  37  50  63  77  90 102 116 52   0   0   0   3  14  25  37  50  63  77  90 102 116
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  63  1   103   95 54   0   0   0   4  27  48  70  89 108 124 140 154 168 54   0   0   0   4  27  48  70  89 108 124 140 154 168
  64  1   103   95 54   0   0   0   4  27  48  70  89 108 124 140 154 168 54   0   0   0   4  27  48  70  89 108 124 140 154 168
  65  1   309  145 54   0   0   0   4  27  48  70  89 108 124 140 154 168 54   0   0   0   4  27  48  70  89 108 124 140 154 168
  66  1   309  145 54   0   0   0   4  27  48  70  89 108 124 140 154 168 54   0   0   0   4  27  48  70  89 108 124 140 154 168
  67  1   103   75 56   0   4  15  27  38  48  58  65  72  77  82  85  88 58   0   7  18  32  45  58  65  73  79  84  88  91  93
  68  1   103   75 56   0   4  15  27  38  48  58  65  72  77  82  85  88 58   0   7  18  32  45  58  65  73  79  84  88  91  93
  69  1   103   95 56   0   4  15  27  38  48  58  65  72  77  82  85  88 58   0   7  18  32  45  58  65  73  79  84  88  91  93
  70  1   103   95 56   0   4  15  27  38  48  58  65  72  77  82  85  88 58   0   7  18  32  45  58  65  73  79  84  88  91  93
      23464106.       0.   4.  11.  26.  48.  70.  93. 115. 138. 158. 174. 190. 206.     0.   2.  26.  78. 122. 165. 201. 231. 256. 277. 294. 306. 320.

  73  2    54  205  1   0   0   0   0   0   0   0   0   0   1   8  14  20  1   0   0   0   0   0   0   0   0   0   1   8  14  20
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  80  2    54   75 12   0   0  31  88 108 142 178 208 231 252 271 286 300 16   0   0  37  97 153 201 240 271 296 316 331 344 354
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  82  2    54  125 15   0  14  57 104 149 189 224 254 278 297 313 327 338 16   0   0  37  97 153 201 240 271 296 316 331 344 354
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  85  2   108  125 22   0   0   0   9  29  50  70  90 110 128 147 164 180 28   0   0  11  56  97 138 166 197 223 246 266 283 299
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  93  2   216   95 42   0   0   0  16  37  61  87 114 142 168 188 220 244 43   0   0   0   0   0  45  88 128 164 198 225 251 274
  94  2   216   95 42   0   0   0  16  37  61  87 114 142 168 188 220 244 43   0   0   0   0   0  45  88 128 164 198 225 251 274
  95  2   162  125 42   0   0   0  16  37  61  87 114 142 168 188 220 244 43   0   0   0   0   0  45  88 128 164 198 225 251 274
  96  2   162  125 42   0   0   0  16  37  61  87 114 142 168 188 220 244 43   0   0   0   0   0  45  88 128 164 198 225 251 274
  97  2   162  205 42   0   0   0  16  37  61  87 114 142 168 188 220 244 43   0   0   0   0   0  45  88 128 164 198 225 251 274
  98  2   162  205 42   0   0   0  16  37  61  87 114 142 168 188 220 244 43   0   0   0   0   0  45  88 128 164 198 225 251 274
  99  2    54   65 43   0   0   0   0   0  45  88 128 164 198 225 251 274 43   0   0   0   0   0  45  88 128 164 198 225 251 274
 100  2    54   65 43   0   0   0   0   0  45  88 128 164 198 225 251 274 43   0   0   0   0   0  45  88 128 164 198 225 251 274
 101  2    54  125 43   0   0   0   0   0  45  88 128 164 198 225 251 274 43   0   0   0   0   0  45  88 128 164 198 225 251 274
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105  2 162  55  44   0   0  11  34  55  85 111 137 162 186 208 229 248  47   4  20  47  84 128 176 220 257 288 312 330 344 355
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123  2  84  85  55  16  30  44  60  78  83 117 130 144 158 171 185 198  55  16  30  44  60  78  83 117 130 144 158 171 185 198
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129  2 108  88  57   0   5  13  21  28  35  41  48  50  54  57  59  61  60  12  28  43  56  68  76  83  89  93  96  99 101 103
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133  2  84  75  58   0   4  15  27  38  48  56  65  72  77  82  85  88  59   0   7  19  32  45  56  65  73  79  84  88  91  93
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       6372111         1   5  13  27  43  63  84 104 125 146 166 186 202       2  10  25  46  70 104 138 169 197 221 242 260 275

143  3 118 205   2   0   0   0   0   0   0  11  24  37  50  63  75  87  16   0   0  37  87 153 201 240 271 288 318 331 344 354
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145  3 118  85   5   0   0   5  13  35  58  83 108 128 148 167 184 200  16   0   0  37  87 153 201 240 271 288 318 331 344 354
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151  3  88  85  21   0   3  12  23  34  45  58  67  77  88  95 103 112  28   0   0  11  56  97 135 168 197 223 246 266 283 299
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159  3  88 205  43   0   0   0  16  37  61  87 114 142 169 196 220 244  43   0   0   0   0   0  45  88 128 164 198 228 251 274
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161  3  88  85  45   0   1   7  15  27  41  59  78 101 124 148 171 193  47   4  20  47  84 128 176 220 257 288 312 330 344 355
162  3  88  85  45   0   1   7  15  27  41  59  78 101 124 148 171 193  47   4  20  47  84 128 176 220 257 288 312 330 344 355
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165  3 264 205  46   0   0  11  34  59  85 111 137 162 186 208 229 248  47   4  20  47  84 128 176 220 257 288 312 330 344 355
166  3 264 205  46   0   0  11  34  59  85 111 137 162 186 208 229 248  47   4  20  47  84 128 176 220 257 288 312 330 344 355
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167  3  88   5  64   0   0   0   4  27  48  70  88 106 124 140 154 166  64   0   0   0   4  27  48  70  88 106 124 140 154 166
168  3  88   5  64   0   0   0   4  27  48  70  88 106 124 140 154 166  64   0   0   0   4  27  48  70  88 106 124 140 154 166
169  3  88  85  64   0   4  15  27  38  48  56  65  72  77  82  85  88  59   0   7  19  32  45  56  65  73  79  84  88  91  93
170  3  88  85  64   0   4  15  27  38  48  56  65  72  77  82  85  88  59   0   7  19  32  45  56  65  73  79  84  88  91  93
171  3  88   5  68   0   7  18  32  48  58  65  73  79  84  88  91  93  59   0   7  19  32  45  56  65  73  79  84  88  91  93
172  3  88   5  68   0   7  18  32  48  58  65  73  79  84  88  91  93  59   0   7  19  32  45  56  65  73  79  84  88  91  93
       2888142         0   5  16  33  51  70  90 109 127 144 161 178 190       1   7  30  70 111 152 188 219 248 266 283 297 308.

173  4  62  38   2   0   0   0   0   0   0  11  24  37  50  63  75  87  16   0   0  37  87 153 201 240 271 288 318 331 344 354
174  4  62  38   2   0   0   0   0   0   0  11  24  37  50  63  75  87  16   0   0  37  87 153 201 240 271 288 318 331 344 354
175  4 124 108  22   0   0   0   8  28  50  70  90 110 128 147 164 180  28   0   0  11  55  97 135 168 197 223 246 266 283 299
176  4 124 108  22   0   0   0   8  28  50  70  90 110 128 147 164 180  28   0   0  11  55  97 135 168 197 223 246 266 283 299
177  4  62 125  31   3  30  60  92 123 152 178 202 223 241 257 272 284  28   0   0  11  55  97 135 168 197 223 246 266 283 299
178  4  62 125  31   3  30  60  92 123 152 178 202 223 241 257 272 284  28   0   0  11  55  97 135 168 197 223 246 266 283 299
179  4  62 205  41   0   0   4  14  24  33  41  48  56  62  68  73  78  43   0   0   0   0   0  45  88 128 164 198 228 251 274
180  4  62 205  41   0   0   4  14  24  33  41  48  56  62  68  73  78  43   0   0   0   0   0  45  88 128 164 198 228 251 274
181  4  62 205  42   0   0   0  16  37  61  87 114 142 169 196 220 244  43   0   0   0   0   0  45  88 128 164 198 228 251 274
182  4  62 205  42   0   0   0  16  37  61  87 114 142 169 196 220 244  43   0   0   0   0   0  45  88 128 164 198 228 251 274
183  4 168 125  43   0   0   0   0   0  45  88 128 164 198 228 251 274  43   0   0   0   0   0  45  88 128 164 198 228 251 274
184  4 168 125  43   0   0   0   0   0  45  88 128 164 198 228 251 274  43   0   0   0   0   0  45  88 128 164 198 228 251 274
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187  4  62 205  44   0   0   0   0   0   0   0   0   0   4  18  33  48  44   0   0   0   0   0   0   0   0   0   4  18  33  48
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189  4 168  38  46   0   0  11  34  59  85 111 137 162 186 208 229 248  47   4  20  47  84 128 176 220 257 288 312 330 344 355
190  4 168  38  46   0   0  11  34  59  85 111 137 162 186 208 229 248  47   4  20  47  84 128 176 220 257 288 312 330 344 355
191  4 168 118  46   0   0  11  34  59  85 111 137 162 186 208 229 248  47   4  20  47  84 128 176 220 257 288 312 330 344 355
192  4 168 118  46   0   0  11  34  59  85 111 137 162 186 208 229 248  47   4  20  47  84 128 176 220 257 288 312 330 344 355
193  4 168 125  46   0   0  11  34  59  85 111 137 162 186 208 229 248  47   4  20  47  84 128 176 220 257 288 312 330 344 355
194  4 168 125  46   0   0  11  34  59  85 111 137 162 186 208 229 248  47   4  20  47  84 128 176 220 257 288 312 330 344 355
195  4  62 205  46   0   0  11  34  59  85 111 137 162 186 208 229 248  47   4  20  47  84 128 176 220 257 288 312 330 344 355
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197  4  62  85  48   3   6  12  20  32  48  70  88 125 157 188 222 253  50   5  12  25  46  77 116 162 210 257 300 339 373 401
198  4  62  85  48   3   6  12  20  32  48  70  88 125 157 188 222 253  50   5  12  25  46  77 116 162 210 257 300 339 373 401
199  4  62 205  55  16  30  44  60  78  83 117 130 144 158 171 185 198  55  16  30  44  60  78  83 117 130 144 158 171 185 198
200  4  62 205  55  16  30  44  60  78  83 117 130 144 158 171 185 198  55  16  30  44  60  78  83 117 130 144 158 171 185 198
201  4  62  75  58   0   4  15  27  38  48  56  65  72  77  82  85  88  59   0   7  19  32  45  56  65  73  79  84  88  91  93
202  4  62  75  58   0   4  15  27  38  48  56  65  72  77  82  85  88  59   0   7  19  32  45  56  65  73  79  84  88  91  93
203  4  62  85  58   0   4  15  27  38  48  56  65  72  77  82  85  88  59   0   7  19  32  45  56  65  73  79  84  88  91  93
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205  4 124 125  58   0   4  15  27  38  48  56  65  72  77  82  85  88  59   0   7  19  32  45  56  65  73  79  84  88  91  93
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       3346122.        0   3.  10.  24.  40.  63.  88 106 130. 150. 168. 186. 203.      2  10.  25.  48.  78 113. 148. 178. 206. 227. 248. 262. 276.

207  5 120  85  41   0   0   4  14  24  33  41  48  56  62  66  73  76  43   0   0   0   0   0  45  88 128 164 198 225 251 274
208  5 120  85  41   0   0   4  14  24  33  41  48  56  62  68  73  78  43   0   0   0   0   0  45  88 128 164 198 225 251 274
209  5  65  85  48   3   6  12  20  32  48  70  88 126 157 188 222 253  50   5  12  25  46  77 118 162 210 257 300 339 373 401
210  5  65  85  48   3   6  12  20  32  48  70  88 126 157 188 222 253  50   5  12  25  46  77 118 162 210 257 300 339 373 401
       390  85         1.   2.   6.  16.  26.  38.  50.  64.  78.  93. 108. 122. 126.      1.   4.   8.  15.  25.  66. 112. 155. 188. 230. 263. 281. 316.

211  5  80  85  22   0   0   0   8  28  50  70  90 110 128 147 164 180  28   0   0  11  55  97 135 168 197 223 246 266 283 299
212  5  80  85  22   0   0   0   8  28  50  70  90 110 128 147 164 180  28   0   0  11  55  97 135 168 197 223 246 266 283 299
213  5 120  85  42   0   0   0  16  37  61  87 114 142 169 196 220 244  43   0   0   0   0   0  45  88 128 164 198 228 251 274
214  5 120  85  42   0   0   0  16  37  61  87 114 142 169 196 220 244  43   0   0   0   0   0  45  88 128 164 198 228 251 274
215  5 160  85  43   0   0   0   0   0  45  88 128 164 198 225 251 274  43   0   0   0   0   0  45  88 128 164 198 225 251 274
216  5 160  85  43   0   0   0   0   0  45  88 128 164 198 225 251 274  43   0   0   0   0   0  45  88 128 164 198 225 251 274
217  5  80 205  44   0   0   0   0   0   0   0   0   0   4  18  33  48  44   0   0   0   0   0   0   0   0   0   4  18  33  48
218  5  80 205  44   0   0   0   0   0   0   0   0   0   4  18  33  48  44   0   0   0   0   0   0   0   0   0   4  18  33  48
       840  85         0    0    0.   5.  14.  43.  72. 100. 128. 151. 178. 198. 210.      0.   0.   1.   6.  13.  51.  88. 118. 148. 176. 201. 224. 245.
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220   7  59 205  61   0   0   4  14  24  33  41  45  55  62  66  73  78  63   0   0   0   0   0  45  88 128 164 198 228 251 274
221   7  59 205  46   0   0  11  34  59  88 111 137 162 188 208 229 248  67   4  20  47  88 128 176 220 257 288 312 330 344 355
222   7  59 205  46   0   0  11  34  59  88 111 137 162 188 208 229 248  67   4  20  47  88 128 176 220 257 288 312 330 344 355
223   7  59 105  48   3   6  12  20  32  49  70  96 125 157 188 222 253  50   5  12  25  46  77 116 162 210 257 300 339 373 401
224   7  59 105  48   3   6  12  20  32  49  70  96 125 157 188 222 253  50   5  12  25  46  77 116 162 210 257 300 339 373 401
225   7  59 205  57   0   5  13  21  28  35  41  46  50  54  57  59  61  60  12  28  43  56  68  78  83  89  93  96  99 101 103
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      472180          0   2  10  23  38  50  65  87  98 116 130 145 160       5  15  28  46  68 103 138 171 200 226 246 267 283

227   8  56 205   7   0   6  38  63  88 111 132 150 165 178 191 201 211  16   0   0  37  87 153 201 240 271 296 316 331 344 354
228   8  56 205   7   0   6  38  63  88 111 132 150 165 178 191 201 211  16   0   0  37  87 153 201 240 271 296 316 331 344 354
229   8  56 205   8   0   0   5  38  68  99 128 155 180 202 221 238 253  16   0   0  37  87 153 201 240 271 296 316 331 344 354
230   8  56 205   8   0   0   5  38  68  99 128 155 180 202 221 238 253  16   0   0  37  87 153 201 240 271 296 316 331 344 354
231   8  56 105  14   0  39  79 115 146 172 193 211 225 238 249 258 264  16   0   0  37  87 153 201 240 271 296 316 331 344 354
232   8  56 105  14   0  39  79 115 146 172 193 211 225 238 249 258 264  16   0   0  37  87 153 201 240 271 296 316 331 344 354
233   8  56 205  18   0   0   0   0   0   0   0   2  19  35  50  64  77  28   0   0  11  56  87 135 166 187 223 246 266 283 299
234   8  56 205  18   0   0   0   0   0   0   0   2  19  35  50  64  77  28   0   0  11  56  87 135 166 187 223 246 266 283 299
235   8  56 105  32   0   0  43  94 141 181 216 247 273 296 316 333 347  28   0   0  11  56  87 135 166 187 223 246 266 283 299
236   8  56 105  32   0   0  43  94 141 181 216 247 273 296 316 333 347  28   0   0  11  56  87 135 166 187 223 246 266 283 299
237   8  56 205  38   0   2   9  18  28  40  53  65  78  91 103 115 127  38   6  30  58  93 128 162 193 216 240 258 274 287 297
238   8  56 205  38   0   2   9  18  28  40  53  65  78  91 103 115 127  38   6  30  58  93 128 162 193 216 240 258 274 287 297
239   8  56 205  46   0   0  11  34  59  88 111 137 162 188 208 229 248  67   4  20  47  88 128 176 220 257 288 312 330 344 355
240   8  56 205  46   0   0  11  34  59  88 111 137 162 188 208 229 248  67   4  20  47  88 128 176 220 257 288 312 330 344 355
241   8  56 105  48   3   6  12  20  32  49  70  96 125 157 188 222 253  50   5  12  25  46  77 116 162 210 257 300 339 373 401
242   8  56 105  48   3   6  12  20  32  49  70  96 125 157 188 222 253  50   5  12  25  46  77 116 162 210 257 300 339 373 401
243   8  56 205  48   3   6  12  20  32  49  70  96 125 157 188 222 253  50   5  12  25  46  77 116 162 210 257 300 339 373 401
244   8  56 205  48   3   6  12  20  33  49  70  96 125 157 188 222 253  50   5  12  25  46  77 116 162 210 257 300 339 373 401
245   8  56 205  53   0   0   0   3  14  25  37  50  63  77  90 103 115  53   0   0   0   3  14  25  37  50  63  77  90 103 115
246   8  56 205  53   0   0   0   3  14  25  37  50  63  77  90 103 115  53   0   0   0   3  14  25  37  50  63  77  90 103 115
247   8 116 105  57   0   5  13  21  28  35  41  46  50  54  57  59  61  60  12  28  43  56  68  78  83  89  93  96  99 101 103
248   8 116 105  57   0   5  13  21  28  35  41  46  50  54  57  59  61  60  12  28  43  56  68  78  83  89  93  96  99 101 103
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251   8  56  85  58   0   4  15  27  38  49  58  65  72  77  82  85  88  59   0   7  18  32  45  56  65  73  79  84  88  91  93
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253   8 116 105  58   0   4  15  27  38  49  58  65  72  77  82  85  88  59   0   7  18  32  45  56  65  73  79  84  88  91  93
254   8 116 105  58   0   4  15  27  38  49  58  65  72  77  82  85  88  59   0   7  18  32  45  56  65  73  79  84  88  91  93
255   8  56 205  58   0   4  15  27  38  49  58  65  72  77  82  85  88  59   0   7  18  32  45  56  65  73  79  84  88  91  93
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     1572157          0   5  18  33  48  65  80  94 108 122 135 147 157       3  10  28  57  88 112 137 158 178 194 208 220 230

259   9  58  85  14   0  39  79 115 146 172 193 211 225 238 249 258 264  16   0   0  37  87 153 201 240 271 296 316 331 344 354
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261   9  58  85  18   0   0   0   0   0   0   0   2  19  35  50  64  77  28   0   0  11  56  87 135 166 187 223 246 266 283 299
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263   9  58  85  38   4  18  38  64  91 118 145 170 191 211 227 242 264  38   6  30  58  93 128 162 193 216 240 258 274 287 297
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265   9  58 205  41   0   0   4  14  24  33  41  45  55  62  66  73  78  63   0   0   0   0   0  45  88 128 164 198 228 251 274
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267   9  58  85  42   0   0   0  16  37  61  87 114 142 168 198 220 244  43   0   0   0   0   0  45  88 128 164 198 228 251 274
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269   9  58 105  42   0   0   0  16  37  61  87 114 142 168 198 220 244  43   0   0   0   0   0  45  88 128 164 198 228 251 274
270   9  58 105  42   0   0   0  16  37  61  87 114 142 168 198 220 244  43   0   0   0   0   0  45  88 128 164 198 228 251 274
271   9 116 205  42   0   0   0  16  37  61  87 114 142 168 198 220 244  43   0   0   0   0   0  45  88 128 164 198 228 251 274
272   9 116 205  42   0   0   0  16  37  61  87 114 142 168 198 220 244  43   0   0   0   0   0  45  88 128 164 198 228 251 274
273   9 116  85  43   0   0   0   0   0  45  88 128 164 198 228 251 274  43   0   0   0   0   0  45  88 128 164 198 228 251 274
274   9 116  85  43   0   0   0   0   0  45  88 128 164 198 228 251 274  43   0   0   0   0   0  45  88 128 164 198 228 251 274
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277   9  58  85  46   0   0  11  34  59  88 111 137 162 188 208 229 248  67   4  20  47  88 128 176 220 257 288 312 330 344 355
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279   9  58  85  48   3   6  12  20  32  49  70  96 125 157 188 222 253  50   5  12  25  46  77 116 162 210 257 300 339 373 401
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281   9 116  85  58   0   4  15  27  38  49  58  65  72  77  82  85  88  59   0   7  18  32  45  56  65  73  79  84  88  91  93
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     1888124          0   4  11  24  38  61  84 108 128 148 166 188 203       1   6  16  38  44  82 117 148 176 203 226 246 261

287  10 124 205  18   0   0   0   0   0   0   0   2  19  35  50  64  77  28   0   0  11  56  87 135 166 187 223 246 266 283 299
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289  10 124 205  23   0   5  27  47  68  88 108 127 144 160 176 188 202  28   0   0  11  56  87 135 166 187 223 246 266 283 299
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291  10  62 205  38   0   2   9  18  28  40  53  65  78  91 103 115 127  38   6  30  58  93 128 162 193 216 240 258 274 287 297
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293  10  62 105  41   0   0   4  14  24  33  41  45  55  62  66  73  78  63   0   0   0   0   0  45  88 128 164 198 228 251 274
294  10  62 105  41   0   0   4  14  24  33  41  45  55  62  66  73  78  63   0   0   0   0   0  45  88 128 164 198 228 251 274
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296  10  62 205  41   0   0   4  14  24  33  41  45  55  62  66  73  78  63   0   0   0   0   0  45  88 128 164 198 228 251 274
297  10  62  85  42   0   0   0  16  37  61  87 114 142 168 198 220 244  43   0   0   0   0   0  45  88 128 164 198 228 251 274
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305  10  62 205  46   0   1   7  15  27  41  59  78 101 124 148 171 193  47   4  20  47  88 128 176 220 257 288 312 330 344 355
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307  10  62  85  46   0   0  11  34  59  88 111 137 162 188 208 229 248  67   4  20  47  88 128 176 220 257 288 312 330 344 355
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313  10  62 205  48   3   6  12  20  32  49  70  96 125 157 188 222 253  50   5  12  25  46  77 116 162 210 257 300 339 373 401
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317  10 124  85  58   0   4  15  27  38  49  58  65  72  77  82  85  88  59   0   7  18  32  45  56  65  73  79  84  88  91  93
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320  10 124 205  58   0   4  15  27  38  49  58  65  72  77  82  85  88  59   0   7  18  32  45  56  65  73  79  84  88  91  93
     2726185          0   1   6  19  33  52  70  88 108 126 143 158 174       1   6  17  37  58  88 129 160 186 210 230 247 262

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324  11 110 205   2   0   0   0   0   0   0  11  24  37  50  63  75  87  16   0   0  37  87 153 201 240 271 296 316 331 344 354
325  11 165 205  18   0   0   0   0   0   0   0   2  19  35  50  64  77  28   0   0  11  56  87 135 166 187 223 246 266 283 299
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327  11  55 205  18   0   0   5  13  21  28  38  46  54  62  70  77  84  28   0   0  11  56  87 135 166 187 223 246 266 283 299
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[illegible]

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411	14	120	205	42	0	0	0	16	37	61	87	114	142	168	196	220	244	43	0	0	0	0	0	45	88	128	164	196	225	251	274
426	14	120	205	46	0	0	11	34	59	85	111	137	162	188	208	229	246	47	4	20	47	84	128	176	220	257	288	312	330	344	355
425	14	120	205	46	0	0	11	34	59	85	111	137	162	188	208	229	246	47	4	20	47	84	128	176	220	257	288	312	330	344	355
446	14	60	205	55	16	30	46	60	78	93	117	130	144	158	171	185	188	55	16	30	46	60	78	93	117	130	144	158	171	185	188
445	14	60	205	55	16	30	46	60	78	93	117	130	144	158	171	185	188	55	16	30	46	60	78	93	117	130	144	158	171	185	188
		1440145			1	6	21	39	60	82	104	126	148	169	189	208	226		4	11	25	56	83	120	166	188	216	240	261	278	284
457	15	672	95	5	0	0	0	13	35	59	83	106	128	146	167	184	200	18	0	0	37	87	153	201	240	271	288	316	331	344	354
458	15	672	95	5	0	0	0	13	35	59	83	106	128	146	167	184	200	18	0	0	37	87	153	201	240	271	288	316	331	344	354
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460	15	112	125	5	0	0	0	13	35	59	83	106	128	146	167	184	200	18	0	0	37	87	153	201	240	271	288	316	331	344	354
461	15	168	95	10	10	20	33	46	66	84	102	119	135	149	162	173	184	18	0	0	37	87	153	201	240	271	288	316	331	344	354
462	15	168	95	10	10	20	33	46	66	84	102	119	135	149	162	173	184	18	0	0	37	87	153	201	240	271	288	316	331	344	354
463	15	168	95	14	0	39	79	115	148	172	193	211	225	238	249	256	264	18	0	0	37	87	153	201	240	271	288	316	331	344	354
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465	15	56	116	14	0	39	79	115	148	172	193	211	225	238	249	256	264	18	0	0	37	87	153	201	240	271	288	316	331	344	354
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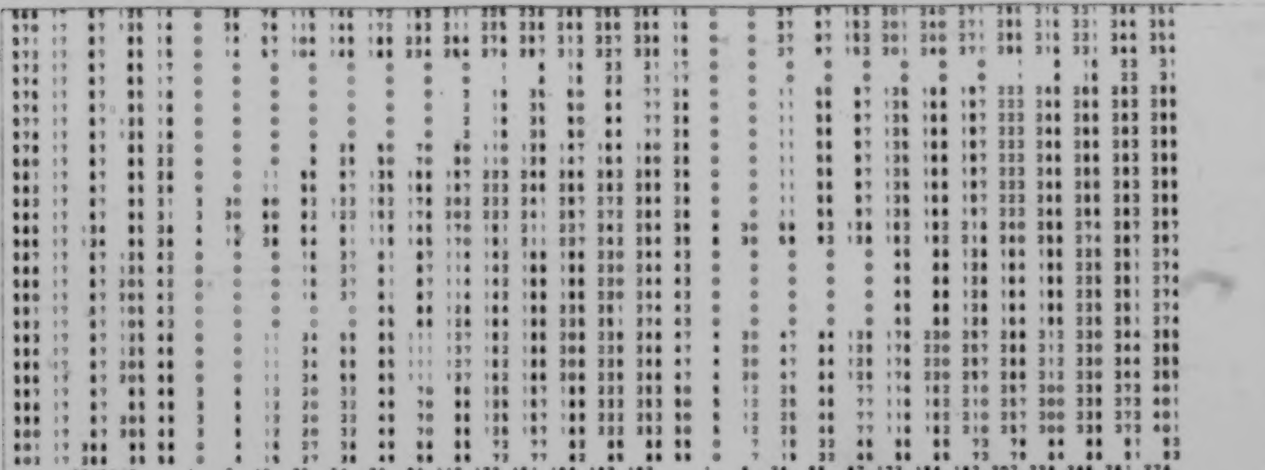

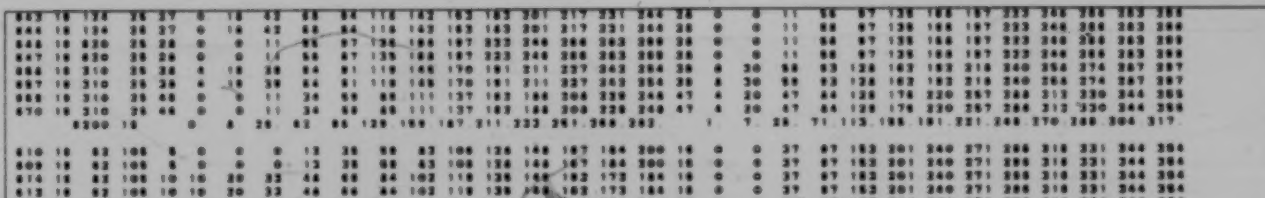

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725 21   63 105 49   3   5  12  20  32  49  70  98 125 157 188 222 253  50   5  12  25  46  77 118 162 210 257 300 338 373 401
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731 21   63 105 54   0   0   0   4  27  48  70  88 108 124 140 154 166  54   0   0   0   4  27  48  70  88 108 124 140 154 166
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734 21  126 105 55   0   4  15  27  38  48  58  65  72  77  82  85  88  55   0   7  19  33  45  56  65  73  79  84  88  91  93
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743 22   60 105  2   0   0   0   0   0   0  11  26  37  50  63  78  87  16   0   0  37  97 153 201 240 271 298 318 331 344 354
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745 22  540 105  5   0   0   0  13  35  59  83 106 128 148 167 184 200  16   0   0  37  97 153 201 240 271 298 318 331 344 354
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749 22  120 105  8   0   0   0   0   8  40  71 100 128 153 176 195 213  16   0   0  37  97 153 201 240 271 298 318 331 344 354
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753 22  180 105 14   0  38  78 115 148 172 193 211 226 238 249 256 264  16   0   0  37  97 153 201 240 271 298 318 331 344 354
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757 22  300 105 22   0   0   0   9  28  50  70  90 110 129 147 164 180  26   0   0  11  56  97 135 166 197 222 246 266 283 299
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779 22   60 125 54   0   0   0   4  27  48  70  88 108 124 140 154 166  54   0   0   0   4  27  48  70  88 108 124 140 154 166
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789 23   67 125 14   0  38  78 115 148 172 193 211 226 238 249 256 264  16   0   0  37  97 153 201 240 271 298 318 331 344 354
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787  23   57  205    7    0    8   35   63   88  111  132  150  165  179  191  201  211   18    0    0   37   97  153  201  240  271  298  316  331  344  354
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810  23   57  205   52    0    0    0    3   14   25   37   50   63   77   90  102  115   52    0    0    0    3   14   25   37   50   63   77   90  102  115
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816  23   57  205   54    0    0    0    4   27   49   70   89  108  124  140  154  166   54    0    0    0    4   27   49   70   89  108  124  140  154  166
818  23   57  205   55   16   30   48   60   78   93  117  130  144  158  171  185  198   55   16   30   48   60   78   93  117  130  144  158  171  185  198
817  23   57  205   55   16   30   48   60   78   93  117  130  144  158  171  185  198   55   16   30   48   60   78   93  117  130  144  158  171  185  198
        1586145         1   10   33   60   90  118  144  167  187  206  222  237  250         2    8   26   65  106  144  177  205  229  249  266  278  291

821  24  280  105    5    0    0    0   13   35   59   83  106  128  148  167  184  200   18    0    0   37   97  153  201  240  271  298  316  331  344  354
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839  24  130  105   18    0    0    0    0    0    0    0    2   19   35   50   64   77   28    0    0   11   56   97  135  168  197  223  246  266  283  299
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847  24   85  105   38    4   19   39   64   91  119  145  170  191  211  227  242  254   38    8   30   59   93  128  162  192  216  240  258  274  287  297
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853  25   63   85   10   10   20   33   48   66   84  102  119  135  149  162  173  184   18    0    0   37   97  153  201  240  271  298  316  331  344  354
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           252 85       5   29   56   81  106  128  147  165  180  193  205  214  224.        0.   0   37   97  153  201  240  271  298  316  331  344  354

857  26   63  105    2    0    0    0    0    0    0   11   24   37   50   63   75   87   18    0    0   37   97  153  201  240  271  298  316  331  344  354
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        6174102.        1.  11.  29.  51.  78. 101. 124. 145. 164. 182. 196. 210. 221.        2.   8.  28.  64. 136. 168. 200. 226. 250. 266. 283. 296. 306

893  27  300  105    2    0    0    0    0    0    0   11   24   37   50   63   75   87   18    0    0   37   97  153  201  240  271  298  316  331  344  354
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1143 31  82 105 18   0   0   0   0   0   0   0   2  18  35  50  64  77 28   0   0  11  58  97 135 168 197 223 246 266 283 299
1144 31  82 105 18   0   0   0   0   0   0   0   2  18  35  50  64  77 28   0   0  11  58  97 135 168 197 223 246 266 283 299
1145 31  82 105 22   0   0   0   9  29  50  70  90 110 129 147 164 180 28   0   0  11  58  97 135 168 197 223 246 266 283 299
1146 31  82 105 22   0   0   0   9  29  50  70  90 110 129 147 164 180 28   0   0  11  58  97 135 168 197 223 246 266 283 299
1147 31 124 105 32   0   0  43  84 141 181 218 247 273 298 315 333 347 28   0   0  11  58  97 135 168 197 223 246 266 283 299
1148 31 124 105 32   0   0  43  84 141 181 218 247 273 298 315 333 347 28   0   0  11  58  97 135 168 197 223 246 266 283 299
1149 31  82 115 32   0   0  43  84 141 181 218 247 273 298 315 333 347 28   0   0  11  58  97 135 168 197 223 246 266 283 299
1150 31  82 115 32   0   0  43  84 141 181 218 247 273 298 315 333 347 28   0   0  11  58  97 135 168 197 223 246 266 283 299
1151 31 124 105 38   4  18  39  64  91 119 145 170 191 211 227 242 254 38   8  30  59  93 128 162 192 218 240 258 274 287 297
1152 31 124 105 38   4  18  39  64  91 119 145 170 191 211 227 242 254 38   8  30  59  93 128 162 192 218 240 258 274 287 297
1153 31  82 205 40   0   0   0   0   0   0   0   0   2   9  17  28  38 40   0   0   0   0   0   0   0   0   2   9  17  28  38
1154 31  82 205 40   0   0   0   0   0   0   0   0   2   9  17  28  38 40   0   0   0   0   0   0   0   0   2   9  17  28  38
1155 31  82 115 43   0   0   0   0   0  45  88 128 164 196 225 251 274 43   0   0   0   0   0  45  88 128 164 196 225 251 274
1156 31  82 115 43   0   0   0   0   0  45  88 128 164 196 225 251 274 43   0   0   0   0   0  45  88 128 164 196 225 251 274
1157 31  82 105 57   0   5  13  21  28  35  41  46  50  54  57  59  61 60  12  28  43  58  68  76  83  89  93  96  99 101 103
1158 31  82 105 57   0   5  13  21  28  35  41  46  50  54  57  59  61 60  12  28  43  58  68  76  83  89  93  96  99 101 103
1159 31 124 105 58   0   4  15  27  38  49  58  65  72  77  82  85  88 59   0   7  18  32  45  56  65  73  79  84  88  91  93
1160 31 124 105 58   0   4  15  27  38  49  58  65  72  77  82  85  88 59   0   7  18  32  45  56  65  73  79  84  88  91  93
1161 31  82 115 58   0   4  15  27  38  49  58  65  72  77  82  85  88 59   0   7  18  32  45  56  65  73  79  84  88  91  93
1162 31  82 115 58   0   4  15  27  38  49  58  65  72  77  82  85  88 59   0   7  18  32  45  56  65  73  79  84  88  91  93
         3472110.    1  10  32  58  84 110 134 155 174 191 205 218 230      1   3  29  74 115 153 185 211 233 251 265 276 285

1167 32 118 115  5   0   0   0  13  35  59  83 108 128 148 167 184 200 16   0   0  37  97 153 201 240 271 298 318 331 344 354
1168 32 118 115  5   0   0   0  13  35  59  83 108 128 148 167 184 200 16   0   0  37  97 153 201 240 271 298 318 331 344 354
1169 32  59 115  6   0   0   0   0   8  40  71 100 128 153 175 195 213 16   0   0  37  97 153 201 240 271 298 318 331 344 354
1170 32  59 115  6   0   0   0   0   8  40  71 100 128 153 175 195 213 16   0   0  37  97 153 201 240 271 298 318 331 344 354
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1171 32  69 105 10  10  20  33  46  66  84 102 119 135 149 162 173 184 16  0  0  37  97 153 201 240 271 286 316 331 344 354
1172 32  69 105 10  10  20  33  46  66  84 102 119 135 149 162 173 184 16  0  0  37  97 153 201 240 271 286 316 331 344 354
1173 32  69 135 11   0  22  56  88 117 142 163 181 197 210 221 231 239 16  0  0  37  97 153 201 240 271 286 316 331 344 354
1174 32  69 135 11   0  22  56  88 117 142 163 181 197 210 221 231 239 16  0  0  37  97 153 201 240 271 286 316 331 344 354
1175 32  69 105 14   0  39  79 115 146 172 193 211 225 238 249 258 264 16  0  0  37  97 153 201 240 271 286 316 331 344 354
1176 32  69 105 14   0  39  79 115 146 172 193 211 225 238 249 258 264 16  0  0  37  97 153 201 240 271 286 316 331 344 354
1177 32 118 115 14   0  39  79 115 146 172 193 211 225 238 249 258 264 16  0  0  37  97 153 201 240 271 286 316 331 344 354
1178 32 118 115 14   0  39  79 115 146 172 193 211 225 238 249 258 264 16  0  0  37  97 153 201 240 271 286 316 331 344 354
1179 32 177 105 15   0  14  57 104 149 189 224 254 278 297 313 327 338 16  0  0  37  97 153 201 240 271 286 316 331 344 354
1180 32 177 105 15   0  14  57 104 149 189 224 254 278 297 313 327 338 16  0  0  37  97 153 201 240 271 286 316 331 344 354
1181 32  69  95 16   0   0  37  97 153 201 240 271 286 316 331 344 354 16  0  0  37  97 153 201 240 271 286 316 331 344 354
1182 32  69  95 16   0   0  37  97 153 201 240 271 286 316 331 344 354 16  0  0  37  97 153 201 240 271 286 316 331 344 354
1183 32  69 105 16   0   0  37  97 153 201 240 271 286 316 331 344 354 16  0  0  37  97 153 201 240 271 286 316 331 344 354
1184 32  69 105 16   0   0  37  97 153 201 240 271 286 316 331 344 354 16  0  0  37  97 153 201 240 271 286 316 331 344 354
1185 32  69 115 22   0   0   0   9  29  50  70  90 110 129 147 164 180 28  0  0  11  56  97 135 168 187 223 246 266 283 299
1186 32  69 115 22   0   0   0   9  29  50  70  90 110 129 147 164 180 28  0  0  11  56  97 135 168 187 223 246 266 283 299
1187 32  69 135 28   0   0  11  56  97 135 168 187 223 246 266 283 299 28  0  0  11  56  97 135 168 187 223 246 266 283 299
1188 32  69 135 28   0   0  11  56  97 135 168 187 223 246 266 283 299 28  0  0  11  56  97 135 168 187 223 246 266 283 299
1189 32 177 115 32   0   0  43  94 141 181 216 247 273 296 315 333 347 28  0  0  11  56  97 135 168 187 223 246 266 283 299
1190 32 177 115 32   0   0  43  94 141 181 216 247 273 296 315 333 347 28  0  0  11  56  97 135 168 187 223 246 266 283 299
1191 32  69 105 35   0   1   5  11  18  26  34  42  50  58  65  72  78 39  8 30  59  93 128 162 192 218 240 258 274 287 297
1192 32  69 105 35   0   1   5  11  18  26  34  42  50  58  65  72  78 39  8 30  59  93 128 162 192 218 240 258 274 287 297
1193 32 118 105 38   4  19  39  64  91 119 145 170 191 211 227 242 254 39  8 30  59  93 128 162 192 218 240 258 274 287 297
1194 32 118 105 38   4  19  39  64  91 119 145 170 191 211 227 242 254 39  8 30  59  93 128 162 192 218 240 258 274 287 297
1195 32  69 115 38   4  19  39  64  91 119 145 170 191 211 227 242 254 39  8 30  59  93 128 162 192 218 240 258 274 287 297
1196 32  69 115 38   4  19  39  64  91 119 145 170 191 211 227 242 254 39  8 30  59  93 128 162 192 218 240 258 274 287 297
1197 32  69 105 43   0   0   0   0   0  45  88 128 164 196 225 251 274 43  0  0   0   0   0  45  88 128 164 196 225 251 274
1198 32  69 105 43   0   0   0   0   0  45  88 128 164 196 225 251 274 43  0  0   0   0   0  45  88 128 164 196 225 251 274
1199 32  69 115 43   0   0   0   0   0  45  88 128 164 196 225 251 274 43  0  0   0   0   0  45  88 128 164 196 225 251 274
1200 32  69 115 43   0   0   0   0   0  45  88 128 164 196 225 251 274 43  0  0   0   0   0  45  88 128 164 196 225 251 274
1201 32  69 115 46   0   0  11  34  59  85 111 137 162 186 206 229 248 47  4 20  47  84 129 176 220 257 288 312 330 344 355
1202 32  69 115 46   0   0  11  34  59  85 111 137 162 186 206 229 248 47  4 20  47  84 129 176 220 257 288 312 330 344 355
1203 32 177 115 51   0   0   0   0   1   2   3   4   5   7   9  12  15 51  0  0   0   0   1   2   3   4   5   7   9  12  15
1204 32 177 115 51   0   0   0   0   1   2   3   4   5   7   9  12  15 51  0  0   0   0   1   2   3   4   5   7   9  12  15
1205 32  69 205 51   0   0   0   0   1   2   3   4   5   7   9  12  15 51  0  0   0   0   1   2   3   4   5   7   9  12  15
1206 32  69 205 51   0   0   0   0   1   2   3   4   5   7   9  12  15 51  0  0   0   0   1   2   3   4   5   7   9  12  15
1207 32  69  95 52   0   0   0   3  14  25  37  50  63  77  90 102 115 52  0  0   0   3  14  25  37  50  63  77  90 102 115
1208 32  69  95 52   0   0   0   3  14  25  37  50  63  77  90 102 115 52  0  0   0   3  14  25  37  50  63  77  90 102 115
1209 32  69 105 52   0   0   0   3  14  25  37  50  63  77  90 102 115 52  0  0   0   3  14  25  37  50  63  77  90 102 115
1210 32  69 105 52   0   0   0   3  14  25  37  50  63  77  90 102 115 52  0  0   0   3  14  25  37  50  63  77  90 102 115
1211 32  69 115 52   0   0   0   3  14  25  37  50  63  77  90 102 115 52  0  0   0   3  14  25  37  50  63  77  90 102 115
1212 32  69 115 52   0   0   0   3  14  25  37  50  63  77  90 102 115 52  0  0   0   3  14  25  37  50  63  77  90 102 115
1213 32  69 205 53   0   0   0   0   0   1   4   8  12  17  22  27  32 53  0  0   0   0   0   1   4   8  12  17  22  27  32
1214 32  69 205 53   0   0   0   0   0   1   4   8  12  17  22  27  32 53  0  0   0   0   0   1   4   8  12  17  22  27  32
1215 32 118 115 54   0   0   0   4  27  48  70  89 108 124 140 154 166 54  0  0   0   4  27  48  70  89 108 124 140 154 166
1216 32 118 115 54   0   0   0   4  27  48  70  89 108 124 140 154 166 54  0  0   0   4  27  48  70  89 108 124 140 154 166
1217 32  69  95 58   0   4  15  27  38  48  56  65  72  77  82  85  88 59  0  7  19  32  45  56  65  73  79  84  88  91  93
1218 32  69  95 58   0   4  15  27  38  48  56  65  72  77  82  85  88 59  0  7  19  32  45  56  65  73  79  84  88  91  93
1219 32  69 105 58   0   4  15  27  38  48  56  65  72  77  82  85  88 59  0  7  19  32  45  56  65  73  79  84  88  91  93
1220 32  69 105 58   0   4  15  27  38  48  56  65  72  77  82  85  88 59  0  7  19  32  45  56  65  73  79  84  88  91  93
1221 32  69 115 58   0   4  15  27  38  48  56  65  72  77  82  85  88 59  0  7  19  32  45  56  65  73  79  84  88  91  93
1222 32  69 115 58   0   4  15  27  38  48  56  65  72  77  82  85  88 59  0  7  19  32  45  56  65  73  79  84  88  91  93
        4484118   0   7  23  44  67  91 113.133 150.166 180 192 203.    0.  4. 23. 55. 88.119.147.170.188.208.220 232 243.

1223 33 285  95  5   0   0   0  13  35  59  83 106 126 148 167 184 200 16  0  0  37  97 153 201 240 271 286 316 331 344 354
1224 33 285  95  5   0   0   0  13  35  59  83 106 126 148 167 184 200 16  0  0  37  97 153 201 240 271 286 316 331 344 354
1225 33 188  95 14   0  39  79 115 146 172 193 211 225 238 249 258 264 16  0  0  37  97 153 201 240 271 286 316 331 344 354
1226 33 188  95 14   0  39  79 115 146 172 193 211 225 238 249 258 264 16  0  0  37  97 153 201 240 271 286 316 331 344 354
1227 33  53  95 16   0   0   0   0   0   0   0   2  19  35  50  64  77 28  0  0  11  56  97 135 168 187 223 246 266 283 299
1228 33  53  95 16   0   0   0   0   0   0   0   2  19  35  50  64  77 28  0  0  11  56  97 135 168 187 223 246 266 283 299
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1229 33  53 115 22   0   0   0   9  29  50  70  90 110 129 147 164 180 28  0  0  11  56  97 135 168 187 223 246 266 283 299
1230 33  53 115 22   0   0   0   9  29  50  70  90 110 129 147 164 180 28  0  0  11  56  97 135 168 187 223 246 266 283 299
1231 33  53  95 32   0   0  43  94 141 181 216 247 273 296 315 333 347 28  0  0  11  56  97 135 168 187 223 246 266 283 299
1232 33  53  95 32   0   0  43  94 141 181 216 247 273 296 315 333 347 28  0  0  11  56  97 135 168 187 223 246 266 283 299
1233 33 212  95 38   4  19  39  64  91 119 145 170 191 211 227 242 254 39  8 30  59  93 128 162 192 218 240 258 274 287 297
1234 33 212  95 38   4  19  39  64  91 119 145 170 191 211 227 242 254 39  8 30  59  93 128 162 192 218 240 258 274 287 297
1235 33  53  95 42   0   0   0  16  37  61  87 114 142 169 196 220 244 43  0  0   0   0   0  45  88 128 164 196 225 251 274
1236 33  53  95 42   0   0   0  16  37  61  87 114 142 169 196 220 244 43  0  0   0   0   0  45  88 128 164 196 225 251 274
1237 33  53 115 42   0   0   0  16  37  61  87 114 142 169 196 220 244 43  0  0   0   0   0  45  88 128 164 196 225 251 274
1238 33  53 115 42   0   0   0  16  37  61  87 114 142 169 196 220 244 43  0  0   0   0   0  45  88 128 164 196 225 251 274
1239 33 189  95 43   0   0   0   0   0  45  88 128 164 196 225 251 274 43  0  0   0   0   0  45  88 128 164 196 225 251 274
1240 33 189  95 43   0   0   0   0   0  45  88 128 164 196 225 251 274 43  0  0   0   0   0  45  88 128 164 196 225 251 274
1241 33  53  95 46   0   0  11  34  59  85 111 137 162 186 206 229 248 47  4 20  47  84 129 176 220 257 288 312 330 344 355
1242 33  53  95 46   0   0  11  34  59  85 111 137 162 186 206 229 248 47  4 20  47  84 129 176 220 257 288 312 330 344 355
1243 33 108 205 46   0   0  11  34  59  85 111 137 162 186 206 229 248 47  4 20  47  84 129 176 220 257 288 312 330 344 355
1244 33 108 205 46   0   0  11  34  59  85 111 137 162 186 206 229 248 47  4 20  47  84 129 176 220 257 288 312 330 344 355
1245 33 371  95 49   3   8  12  20  32  48  70  96 125 157 189 222 253 50  5 12  25  46  77 118 162 210 257 300 338 373 401
1246 33 371  95 49   3   8  12  20  32  48  70  96 125 157 189 222 253 50  5 12  25  46  77 118 162 210 257 300 338 373 401
1247 33  53 115 49   3   8  12  20  32  48  70  96 125 157 189 222 253 50  5 12  25  46  77 118 162 210 257 300 338 373 401
1248 33  53 115 49   3   8  12  20  32  48  70  96 125 157 189 222 253 50  5 12  25  46  77 118 162 210 257 300 338 373 401
1249 33 212 115 51   0   0   0   0   1   2   3   4   5   7   9  12  15 51  0  0   0   0   1   2   3   4   5   7   9  12  15
1250 33 212 115 51   0   0   0   0   1   2   3   4   5   7   9  12  15 51  0  0   0   0   1   2   3   4   5   7   9  12  15
1251 33 108  95 52   0   0   0   3  14  25  37  50  63  77  90 102 115 52  0  0   0   3  14  25  37  50  63  77  90 102 115
1252 33 108  95 52   0   0   0   3  14  25  37  50  63  77  90 102 115 52  0  0   0   3  14  25  37  50  63  77  90 102 115
1253 33  53  95 54   0   0   0   4  27  48  70  89 108 124 140 154 166 54  0  0   0   4  27  48  70  89 108 124 140 154 166
1254 33  53  95 54   0   0   0   4  27  48  70  89 108 124 140 154 166 54  0  0   0   4  27  48  70  89 108 124 140 154 166
1255 33  53 115 54   0   0   0   4  27  48  70  89 108 124 140 154 166 54  0  0   0   4  27  48  70  89 108 124 140 154 166
1256 33  53 115 54   0   0   0   4  27  48  70  89 108 124 140 154 166 54  0  0   0   4  27  48  70  89 108 124 140 154 166
1257 33 984  95 58   0   4  15  27  38  48  56  65  72  77  82  85  88 59  0  7  19  32  45  56  65  73  79  84  88  91  93
1258 33 984  95 58   0   4  15  27  38  48  56  65  72  77  82  85  88 59  0  7  19  32  45  56  65  73  79  84  88  91  93
        8042101   0.  5. 14. 27. 42. 60. 78. 95.112 128.143.157.170.    1.  7. 21. 44. 68. 96.122.146.167.185.200 214.228.
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11. Appendix III - The number of trees per ha for the main species

The number of trees per hectare as a function of age was determined by fitting a least squares straight line to PSP data from the company for each species below:

Lodgepole pine: # of TREES/HA = 2374 - 103 AGE/10

White spruce: # of TREES/HA = 1105 - 50.4 AGE/10

Black spruce: # of TREES/HA = 1643 - 18.0 AGE/10

Alpine/Balsam fir: # of TREES/HA = 1405 - 45.6 AGE/10

Mixed softwood: # of TREES/HA = 351 - 20.0 AGE/10

12. Appendix IV - The tree sizes and woodlands costs for each yield stream by age class

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 First rows : the identity of yield streams
 Second rows: the tree sizes (m3/tree) from 3 to 15 decades
 Third rows : woodlands costs ($/m3) from 3 to 15 decades

Woodlands cost = 8.9465 - 2.6288 * LNLOG(TREE SIZE)
 * LNLOG : Natural logarithm


  1
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0009 0.0078 0.0151 0.0243
 0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000 27.434 21.717 19.869 18.718

  2
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0075 0.0179 0.0299 0.0441 0.0612 0.0809 0.1057
 0.000  0.000  0.000  0.000  0.000  0.000 21.788 19.521 18.172 17.156 16.292 15.557 14.884

  3
0.0000 0.0000 0.0000 0.0000 0.0055 0.0186 0.0305 0.0483 0.0639 0.0855 0.1097 0.1392 0.1738
 0.000  0.000  0.000  0.000 22.646 19.468 18.124 17.026 16.178 15.406 14.756 14.131 13.547

  4
0.0000 0.0000 0.0081 0.0217 0.0370 0.0524 0.0693 0.0873 0.1067 0.1289 0.1534 0.1812 0.2183
 0.000  0.000 21.614 19.020 17.615 16.700 15.965 15.356 14.829 14.333 13.875 13.436 12.972

  5
0.0000 0.0000 0.0000 0.0074 0.0212 0.0381 0.0575 0.0791 0.1035 0.1305 0.1621 0.1985 0.2430
 0.000  0.000  0.000 21.840 19.076 17.534 16.455 15.616 14.910 14.297 13.728 13.197 12.665

  6
0.0000 0.0000 0.0000 0.0000 0.0048 0.0259 0.0492 0.0746 0.1035 0.1350 0.1699 0.2104 0.2588
 0.000  0.000  0.000  0.000 22.966 18.565 16.866 15.769 14.910 14.210 13.606 13.045 12.500

  7
0.0000 0.0031 0.0188 0.0359 0.0533 0.0716 0.0914 0.1118 0.1334 0.1580 0.1854 0.2188 0.2584
 0.000 24.184 19.366 17.681 16.662 15.872 15.236 14.703 14.242 13.787 13.376 12.965 12.525

  8
0.0000 0.0000 0.0048 0.0217 0.0412 0.0640 0.0888 0.1157 0.1455 0.1783 0.2146 0.2587 0.3074
 0.000  0.000 22.957 19.020 17.330 16.173 15.316 14.617 14.013 13.479 12.993 12.521 12.047

  9
0.0000 0.0000 0.0000 0.0053 0.0315 0.0564 0.0848 0.1184 0.1526 0.1896 0.2291 0.2751 0.3293
 0.000  0.000  0.000 22.279 18.035 16.394 15.316 14.533 13.865 13.316 12.820 12.339 11.867

 10
0.0048 0.0102 0.0178 0.0274 0.0400 0.0543 0.0708 0.0888 0.1081 0.1315 0.1573 0.1866 0.2236
22.959 20.999 19.541 18.406 17.406 16.605 15.913 15.312 14.770 14.279 13.809 13.359 12.884

 11
0.0000 0.0112 0.0302 0.0502 0.0709 0.0916 0.1129 0.1381 0.1593 0.1853 0.2146 0.2492 0.2904
 0.000 20.749 18.151 16.813 15.903 15.225 14.681 14.208 13.776 13.377 12.993 12.599 12.197

 12
0.0000 0.0000 0.0167 0.0368 0.0642 0.0924 0.1218 0.1530 0.1867 0.2224 0.2631 0.3085 0.3648
 0.000  0.000 19.705 17.490 16.163 15.206 14.479 13.882 13.354 12.898 12.456 12.038 11.589

 13
0.0000 0.0000 0.0011 0.0296 0.0612 0.0944 0.1281 0.1634 0.1997 0.2383 0.2806 0.3290 0.3864
 0.000  0.000 25.811 18.198 16.280 15.152 14.348 13.708 13.182 12.717 12.287 11.869 11.446

 14
0.0000 0.0188 0.0425 0.0656 0.0886 0.1112 0.1337 0.1575 0.1818 0.2101 0.2417 0.2782 0.3208
 0.000 19.244 17.248 16.108 15.321 14.721 14.237 13.806 13.427 13.048 12.679 12.329 11.935

 15
0.0000 0.0071 0.0307 0.0583 0.0903 0.1232 0.1551 0.1898 0.2247 0.2621 0.3039 0.3528 0.4107
 0.000 21.937 18.104 16.374 15.286 14.473 13.845 13.316 12.871 12.466 12.076 11.686 11.286

 16
0.0000 0.0000 0.0189 0.0553 0.0927 0.1299 0.1652 0.2022 0.2393 0.2788 0.3214 0.3711 0.4301
 0.000  0.000 19.240 16.557 15.196 14.311 13.684 13.146 12.708 12.303 11.931 11.552 11.164

 17
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0004 0.0071 0.0155 0.0246 0.0377
 0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000 27.868 21.957 19.885 18.684 17.566

 18
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0015 0.0164 0.0305 0.0485 0.0680 0.0936
 0.000  0.000  0.000  0.000  0.000  0.000  0.000 26.053 19.924 18.088 16.899 15.973 15.175

 19
0.0000 0.0000 0.0027 0.0074 0.0127 0.0187 0.0263 0.0342 0.0437 0.0547 0.0680 0.0831 0.1021
 0.000  0.000 24.503 21.840 20.419 19.401 18.509 17.810 17.178 16.584 16.015 15.487 14.948

 20
0.0000 0.0000 0.0000 0.0000 0.0036 0.0136 0.0249 0.0386 0.0542 0.0724 0.0942 0.1197 0.1507
 0.000  0.000  0.000  0.000 23.712 20.249 18.651 17.498 16.611 15.848 15.157 14.528 13.922

 21
0.0000 0.0015 0.0065 0.0131 0.0206 0.0291 0.0366 0.0500 0.0622 0.0759 0.0922 0.1111 0.1361
 0.000 25.987 22.200 20.340 19.152 18.248 17.490 16.822 16.248 15.724 15.212 14.723 14.190

 22
0.0000 0.0000 0.0000 0.0051 0.0178 0.0322 0.0485 0.0672 0.0889 0.1139 0.1427 0.1759 0.2187
 0.000  0.000  0.000 22.807 19.570 17.968 16.903 16.046 15.306 14.656 14.064 13.500 12.942

 23
0.0000 0.0041 0.0145 0.0288 0.0412 0.0589 0.0746 0.0948 0.1184 0.1412 0.1709 0.2039 0.2484
 0.000 23.408 20.089 18.481 17.330 16.453 15.763 15.141 14.600 14.092 13.591 13.127 12.839

 24
0.0000 0.0000 0.0000 0.0114 0.0339 0.0575 0.0824 0.1097 0.1362 0.1703 0.2068 0.2492 0.3001
 0.000  0.000  0.000 20.706 17.840 16.452 15.506 14.755 14.148 13.559 13.050 12.559 12.110

 25
0.0000 0.0000 0.0036 0.0177 0.0345 0.0543 0.0763 0.1007 0.1292 0.1606 0.1971 0.2406 0.2926
 0.000  0.000 23.817 19.585 17.784 16.606 15.715 14.960 14.323 13.754 13.216 12.692 12.176

 26
0.0005 0.0077 0.0172 0.0278 0.0406 0.0543 0.0693 0.0851 0.1036 0.1227 0.1456 0.1718 0.2041
28.012 21.766 19.622 18.362 17.369 16.606 15.965 15.424 14.910 14.462 14.011 13.581 13.124

 27
0.0000 0.0052 0.0226 0.0366 0.0570 0.0783 0.0983 0.1216 0.1479 0.1774 0.2107 0.2492 0.2955
 0.000 21.276 18.907 17.490 16.479 15.711 15.044 14.485 13.970 13.492 13.041 12.599 12.143

 28
0.0000 0.0000 0.0058 0.0316 0.0588 0.0873 0.1163 0.1470 0.1803 0.2171 0.2563 0.3053 0.3623
```

```
 0.000   0.000 22.425 19.001 16.386 15.354 14.602 13.886 13.450 12.981 12.505 12.066 11.605
 29
0.0000 0.0000 0.0135 0.0328 0.0552 0.0802 0.1080 0.1386 0.1730 0.2101 0.2553 0.3053 0.3870
 0.000  0.000 20.271 17.954 16.584 15.541 14.766 14.136 13.558 13.037 12.535 12.088 11.562

 30
0.0029 0.0117 0.0237 0.0371 0.0521 0.0685 0.0866 0.1045 0.1248 0.1485 0.1718 0.2005 0.2357
24.302 20.839 18.785 17.609 16.712 15.983 15.379 14.864 14.424 13.995 13.576 13.169 12.748

 31
0.0015 0.0152 0.0323 0.0525 0.0745 0.0983 0.1233 0.1507 0.1803 0.2127 0.2485 0.2934 0.3481
25.124 18.934 17.570 16.595 15.772 15.046 14.450 13.921 13.450 13.015 12.596 12.170 11.743

 32
0.0000 0.0000 0.0222 0.0536 0.0855 0.1170 0.1495 0.1843 0.2207 0.2613 0.3058 0.3582 0.4218
 0.000  0.000 18.845 16.838 15.413 14.667 13.941 13.392 12.919 12.475 12.061 11.638 11.217

 33
0.0000 0.0051 0.0258 0.0502 0.0782 0.1089 0.1434 0.1799 0.2191 0.2629 0.3126 0.3711 0.4398
 0.000 22.822 18.558 16.813 15.647 14.752 14.053 13.457 12.936 12.449 12.003 11.552 11.108

 34
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0007 0.0024 0.0044 0.0058 0.0087 0.0134
 0.000  0.000  0.000  0.000  0.000  0.000  0.000 27.875 24.777 23.203 22.086 21.130 20.290

 35
0.0000 0.0005 0.0027 0.0063 0.0109 0.0165 0.0235 0.0312 0.0404 0.0512 0.0631 0.0777 0.0948
 0.000 28.875 24.502 22.279 20.624 19.668 18.801 18.049 17.381 16.760 16.210 15.664 15.141

 36
0.0000 0.0010 0.0046 0.0106 0.0176 0.0259 0.0367 0.0483 0.0631 0.0803 0.1000 0.1241 0.1543
 0.000 27.052 22.857 20.842 19.570 18.555 17.634 16.861 16.212 15.576 15.000 14.433 13.859

 37
0.0010 0.0061 0.0135 0.0234 0.0352 0.0474 0.0616 0.0781 0.0914 0.1077 0.1282 0.1487 0.1725
27.190 22.342 20.271 18.820 17.748 16.936 16.272 15.717 15.237 14.808 14.388 13.992 13.596

 38
0.0019 0.0087 0.0210 0.0365 0.0552 0.0769 0.1004 0.1269 0.1544 0.1862 0.2204 0.2611 0.3088
25.368 21.134 19.102 17.890 16.864 15.669 14.989 14.374 13.858 13.365 12.922 12.477 12.037

 39
0.0039 0.0153 0.0318 0.0530 0.0776 0.1047 0.1330 0.1627 0.1940 0.2277 0.2680 0.3089 0.3608
23.545 19.934 18.014 16.887 15.857 14.878 14.251 13.720 13.257 12.836 12.428 12.029 11.626

 40
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0038 0.0180 0.0378 0.0652 0.1032
 0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000 23.712 19.507 17.559 16.125 14.918

 41
0.0000 0.0000 0.0047 0.0175 0.0319 0.0470 0.0630 0.0815 0.1016 0.1240 0.1511 0.1830 0.2235
 0.000  0.000 23.043 19.588 18.002 16.984 16.215 15.536 14.952 14.434 13.914 13.412 12.888

 42
0.0000 0.0000 0.0000 0.0200 0.0492 0.0869 0.1336 0.1897 0.2582 0.3380 0.4356 0.5514 0.6991
 0.000  0.000  0.000 19.227 16.884 15.359 14.227 13.317 12.508 11.798 11.131 10.512  9.887

 43
0.0000 0.0000 0.0000 0.0000 0.0000 0.0641 0.1362 0.2130 0.2962 0.3920 0.5000 0.6291 0.7881
```

```
 0.000  0.000  0.000  0.000  0.000 16.168 14.207 13.012 12.127 11.405 10.789 10.185  9.582

 44
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0080 0.0400 0.0827 0.1404
 0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000 21.839 17.408 15.489 14.107

 45
0.0000 0.0011 0.0082 0.0187 0.0358 0.0584 0.0906 0.1314 0.1836 0.2480 0.3289 0.4286 0.5530
 0.000 26.837 21.572 19.407 17.692 16.413 15.256 14.261 13.402 12.612 11.870 11.174 10.504

 46
0.0000 0.0000 0.0128 0.0424 0.0785 0.1211 0.1705 0.2280 0.2945 0.3720 0.4622 0.5738 0.7106
 0.000  0.000 20.384 17.288 15.837 14.497 13.597 12.833 12.180 11.548 10.975 10.408  9.848

 47
0.0042 0.0221 0.0551 0.1047 0.1718 0.2507 0.3378 0.4276 0.5236 0.6240 0.7323 0.8522 1.0173
23.338 18.982 16.588 14.878 13.581 12.582 11.798 11.180 10.647 10.168  9.762  9.338  8.802

 48
0.0000 0.0011 0.0023 0.0025 0.0040 0.0057 0.0082 0.0118 0.0164 0.0240 0.0311 0.0451 0.0630
 0.000 26.837 24.865 24.703 23.484 22.531 21.287 20.652 19.758 18.761 18.088 17.082 16.313

 49
0.0031 0.0086 0.0141 0.0249 0.0426 0.0696 0.1075 0.1587 0.2273 0.3140 0.4200 0.5564 0.7269
24.094 22.127 20.155 18.850 17.248 15.945 14.809 13.768 12.841 11.992 11.227 10.488  9.793

 50
0.0052 0.0133 0.0283 0.0574 0.1024 0.1652 0.2466 0.3494 0.4673 0.6000 0.7533 0.9248 1.1490
22.751 20.305 18.226 16.481 14.937 13.678 12.603 11.711 10.947 10.289  9.691  9.124  8.561

 51
0.0000 0.0000 0.0000 0.0000 0.0007 0.0013 0.0020 0.0027 0.0038 0.0045 0.0064 0.0088 0.0109
 0.000  0.000  0.000  0.000 26.201 25.368 25.282 24.483 23.844 22.927 22.231 21.442 20.820

 52
0.0000 0.0000 0.0000 0.0020 0.0082 0.0187 0.0260 0.0342 0.0428 0.0539 0.0629 0.0732 0.0836
 0.000  0.000  0.000 25.344 21.284 19.708 18.647 17.824 17.164 16.622 16.178 15.817 15.485

 53
0.0000 0.0000 0.0000 0.0000 0.0000 0.0007 0.0027 0.0055 0.0083 0.0119 0.0155 0.0194 0.0233
 0.000  0.000  0.000  0.000  0.000 26.170 24.499 22.861 21.543 20.594 19.861 19.311 18.828

 54
0.0000 0.0000 0.0000 0.0026 0.0176 0.0327 0.0472 0.0608 0.0747 0.0868 0.0984 0.1108 0.1209
 0.000  0.000  0.000 24.568 19.837 17.938 16.871 16.208 15.787 15.371 15.018 14.734 14.501

 55
0.0126 0.0245 0.0408 0.0531 0.0718 0.0884 0.1177 0.1370 0.1595 0.1841 0.2106 0.2413 0.2748
20.441 18.692 17.357 16.586 16.070 15.393 14.671 14.173 13.773 13.384 13.042 12.689 12.344

 56
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0078 0.0270 0.0548 0.1127 0.1961
 0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000 21.782 18.438 16.574 14.668 13.229

 57
0.0000 0.0185 0.0518 0.0909 0.1327 0.1832 0.2398 0.3046 0.3817 0.4665 0.6284 0.8310 1.1961
 0.000 19.442 16.728 15.280 14.256 13.407 12.701 12.071 11.478 10.841 10.178  9.433  8.478

 58
0.0000 0.0166 0.0586 0.1189 0.1801 0.2585 0.3392 0.4305 0.5496 0.6937 0.9011 1,1972 1.7255
```

```
 0.000 20.839 16.383 14.889 13.853 12.823 11.789 11.162 10.520  9.908  9.220  8.473  7.512

 59
0.0000 0.0258 0.0757 0.1385 0.2133 0.2932 0.3801 0.4834 0.6031 0.7588 0.9870 1.2817 1.8235
 0.000 18.868 15.731 14.143 13.009 12.172 11.489 10.857 10.278  9.679  9.035  8.294  7.367

 60
0.0413 0.1033 0.1713 0.2424 0.3223 0.3979 0.4854 0.5894 0.7059 0.8849 1.0879 1.4225 2.0188
17.328 14.914 13.884 12.872 11.923 11.389 10.847 10.336  9.847  9.328  8.728  8.020  7.089
```

13. Appendix V - The hauling costs from truck to mill

Delivery Cost= 0.7616 + 0.03795(Haul Distance) + 65.7272(1/INSDIAM)

Units: Haul Distance: Km
INSDIAM: Cm (the utilization standard stump diameter inside bark)
Delivery Cost: $\$/m^3$

Determination of representative haul distances:

```
If(0 < Haul Distance <= 20) then
       Haul Distance = 10 Km
Elseif(20 < Haul Distance <= 40) then
            Haul Distance = 30 Km
Elseif(40 < Haul Distance <= 60) then
            Haul Distance = 50 Km
Elseif(60 < Haul Distance <= 80) then
            Haul Distance = 70 Km
Elseif(80 < Haul Distance <= 100) then
            Haul Distance = 90 Km
Elseif(100 < Haul Distance <=120) then
             Haul Distance = 110 Km
Endif
```

14. Appendix VI - The average delivered wood costs for compartment based management units in working circle 1

```
WORKING CIRCLE 1 (20km class grouped data for hauling cost)

First column      the identity of stand
Second column     the identity of compartment
Third column      the area of stand in hectares
Fourth column     the age of stand
Fifth column      the yield stream identity for existing stand
Sixth to Fifteenth    the cost stream ($/m3) for existing stand from 6 to 15 decades
Sixteenth column    the yield stream identity for regeneration stand
Seventeenth to the end    the cost stream ($/m3) for regeneration stand from 6 to 15 decades

The average delivered wood costs (woodlands cost + hauling cost) are below each compartment from 6 to 15 decades

   1  1   412  95  2  0.0  0.0  0.0 28.1 25.8 24.5 23.4 22.6 21.8 21.1 16 22.8 21.5 20.6 19.9 19.4 19.0 18.6 18.2 17.8 17.4
   2  1   412  95  2  0.0  0.0  0.0 28.1 25.8 24.5 23.4 22.6 21.8 21.1 16 22.8 21.5 20.6 19.9 19.4 19.0 18.6 18.2 17.8 17.4
   3  1   103 125  2  0.0  0.0  0.0 28.1 25.8 24.5 23.4 22.6 21.8 21.1 16 22.8 21.5 20.6 19.9 19.4 19.0 18.6 18.2 17.8 17.4
   4  1   103 125  2  0.0  0.0  0.0 28.1 25.8 24.5 23.4 22.6 21.8 21.1 16 22.8 21.5 20.6 19.9 19.4 19.0 18.6 18.2 17.8 17.4
   5  1   103 205  2  0.0  0.0  0.0 28.1 25.8 24.5 23.4 22.6 21.8 21.1 16 22.8 21.5 20.6 19.9 19.4 19.0 18.6 18.2 17.8 17.4
   6  1   103 205  2  0.0  0.0  0.0 28.1 25.8 24.5 23.4 22.6 21.8 21.1 16 22.8 21.5 20.6 19.9 19.4 19.0 18.6 18.2 17.8 17.4
   7  1   103  75  3  0.0 28.9 26.0 24.4 23.3 22.5 21.7 21.0 20.4 19.8 16 22.8 21.5 20.6 19.9 19.4 19.0 18.6 18.2 17.8 17.4
   8  1   103  75  3  0.0 28.9 26.0 24.4 23.3 22.5 21.7 21.0 20.4 19.8 16 22.8 21.5 20.6 19.9 19.4 19.0 18.6 18.2 17.8 17.4
   9  1   103 145  3  0.0 28.9 26.0 24.4 23.3 22.5 21.7 21.0 20.4 19.8 16 22.8 21.5 20.6 19.9 19.4 19.0 18.6 18.2 17.8 17.4
  10  1   103 145  3  0.0 28.9 26.0 24.4 23.3 22.5 21.7 21.0 20.4 19.8 16 22.8 21.5 20.6 19.9 19.4 19.0 18.6 18.2 17.8 17.4
  11  1  3080  95  5 28.1 25.4 23.8 22.7 21.9 21.2 20.6 20.0 19.5 18.9 16 22.8 21.5 20.6 19.9 19.4 19.0 18.6 18.2 17.8 17.4
  12  1  3080  95  5 28.1 25.4 23.8 22.7 21.9 21.2 20.6 20.0 19.5 18.9 16 22.8 21.5 20.6 19.9 19.4 19.0 18.6 18.2 17.8 17.4
  13  1   103 115  5 28.1 25.4 23.8 22.7 21.9 21.2 20.6 20.0 19.5 18.9 16 22.8 21.5 20.6 19.9 19.4 19.0 18.6 18.2 17.8 17.4
  14  1   103 115  5 28.1 25.4 23.8 22.7 21.9 21.2 20.6 20.0 19.5 18.9 16 22.8 21.5 20.6 19.9 19.4 19.0 18.6 18.2 17.8 17.4
  15  1   206 125  5 28.1 25.4 23.8 22.7 21.9 21.2 20.6 20.0 19.5 18.9 16 22.8 21.5 20.6 19.9 19.4 19.0 18.6 18.2 17.8 17.4
  16  1   206 125  5 28.1 25.4 23.8 22.7 21.9 21.2 20.6 20.0 19.5 18.9 16 22.8 21.5 20.6 19.9 19.4 19.0 18.6 18.2 17.8 17.4
  17  1  1030  95  6  0.0 29.2 24.8 23.1 22.1 21.2 20.5 19.9 19.3 18.8 16 22.8 21.5 20.6 19.9 19.4 19.0 18.6 18.2 17.8 17.4
  18  1  1030  95  6  0.0 29.2 24.8 23.1 22.1 21.2 20.5 19.9 19.3 18.8 16 22.8 21.5 20.6 19.9 19.4 19.0 18.6 18.2 17.8 17.4
  19  1   615  95 10 24.7 23.7 22.9 22.2 21.6 21.1 20.6 20.1 19.6 19.2 16 22.8 21.5 20.6 19.9 19.4 19.0 18.6 18.2 17.8 17.4
  20  1   615  95 10 24.7 23.7 22.9 22.2 21.6 21.1 20.6 20.1 19.6 19.2 16 22.8 21.5 20.6 19.9 19.4 19.0 18.6 18.2 17.8 17.4
  21  1   412  95 14 22.4 21.6 21.0 20.5 20.1 19.7 19.3 19.0 18.6 18.2 16 22.8 21.5 20.6 19.9 19.4 19.0 18.6 18.2 17.8 17.4
  22  1   412  95 14 22.4 21.6 21.0 20.5 20.1 19.7 19.3 19.0 18.6 18.2 16 22.8 21.5 20.6 19.9 19.4 19.0 18.6 18.2 17.8 17.4
  23  1   618  95 15 22.7 21.8 20.8 20.1 19.6 19.2 18.7 18.4 18.0 17.6 16 22.8 21.5 20.6 19.9 19.4 19.0 18.6 18.2 17.8 17.4
  24  1   618  95 15 22.7 21.8 20.8 20.1 19.6 19.2 18.7 18.4 18.0 17.6 16 22.8 21.5 20.6 19.9 19.4 19.0 18.6 18.2 17.8 17.4
  25  1   103  95 16 22.8 21.5 20.6 19.9 19.4 19.0 18.6 18.2 17.8 17.4 16 22.8 21.5 20.6 19.9 19.4 19.0 18.6 18.2 17.8 17.4
  26  1   103  95 16 22.8 21.5 20.6 19.9 19.4 19.0 18.6 18.2 17.8 17.4 16 22.8 21.5 20.6 19.9 19.4 19.0 18.6 18.2 17.8 17.4
  27  1   206  35 18  0.0  0.0  0.0  0.0 32.3 28.2 24.4 23.2 22.3 21.5 28 24.3 22.7 21.6 20.9 20.3 19.7 19.2 18.8 18.3 17.9
  28  1   206  35 18  0.0  0.0  0.0  0.0 32.3 28.2 24.4 23.2 22.3 21.5 28 24.3 22.7 21.6 20.9 20.3 19.7 19.2 18.8 18.3 17.9
  29  1   827  95 22 29.1 25.9 24.3 23.2 22.3 21.6 20.9 20.3 19.8 19.2 28 24.3 22.7 21.6 20.9 20.3 19.7 19.2 18.8 18.3 17.9
  30  1   827  95 22 29.1 25.9 24.3 23.2 22.3 21.6 20.9 20.3 19.8 19.2 28 24.3 22.7 21.6 20.9 20.3 19.7 19.2 18.8 18.3 17.9
  31  1   309 105 22 29.1 25.9 24.3 23.2 22.3 21.6 20.9 20.3 19.8 19.2 28 24.3 22.7 21.6 20.9 20.3 19.7 19.2 18.8 18.3 17.9
  32  1   309 105 22 29.1 25.9 24.3 23.2 22.3 21.6 20.9 20.3 19.8 19.2 28 24.3 22.7 21.6 20.9 20.3 19.7 19.2 18.8 18.3 17.9
  33  1   103 205 23 24.7 23.6 22.8 22.0 21.4 20.9 20.4 19.9 19.4 18.9 28 24.3 22.7 21.6 20.9 20.3 19.7 19.2 18.8 18.3 17.9
  34  1   103 205 23 24.7 23.6 22.8 22.0 21.4 20.9 20.4 19.9 19.4 18.9 28 24.3 22.7 21.6 20.9 20.3 19.7 19.2 18.8 18.3 17.9
  35  1   206 205 24 27.0 24.1 22.7 21.8 21.0 20.4 19.9 19.4 18.9 18.4 28 24.3 22.7 21.6 20.9 20.3 19.7 19.2 18.8 18.3 17.9
  36  1   206 205 24 27.0 24.1 22.7 21.8 21.0 20.4 19.9 19.4 18.9 18.4 28 24.3 22.7 21.6 20.9 20.3 19.7 19.2 18.8 18.3 17.9
  37  1   309  95 31 23.0 22.1 21.3 20.7 20.2 19.7 19.3 18.9 18.5 18.0 28 24.3 22.7 21.6 20.9 20.3 19.7 19.2 18.8 18.3 17.9
  38  1   309  95 31 23.0 22.1 21.3 20.7 20.2 19.7 19.3 18.9 18.5 18.0 28 24.3 22.7 21.6 20.9 20.3 19.7 19.2 18.8 18.3 17.9
  39  1   206 115 32 22.9 21.7 20.9 20.2 19.7 19.2 18.8 18.3 17.9 17.5 28 24.3 22.7 21.6 20.9 20.3 19.7 19.2 18.8 18.3 17.9
  40  1   206 115 32 22.9 21.7 20.9 20.2 19.7 19.2 18.8 18.3 17.9 17.5 28 24.3 22.7 21.6 20.9 20.3 19.7 19.2 18.8 18.3 17.9
  41  1   103  95 35 28.6 27.1 26.0 25.1 24.3 23.7 23.0 22.5 21.9 21.4 39 23.0 22.0 21.2 20.5 20.0 19.5 19.1 18.7 18.3 17.9
  42  1   103  95 35 28.6 27.1 26.0 25.1 24.3 23.7 23.0 22.5 21.9 21.4 39 23.0 22.0 21.2 20.5 20.0 19.5 19.1 18.7 18.3 17.9
  43  1   103  95 38 23.9 22.8 22.0 21.3 20.7 20.1 19.6 19.2 18.8 18.3 39 23.0 22.0 21.2 20.5 20.0 19.5 19.1 18.7 18.3 17.9

  44  1   103  95 38 23.9 22.8 22.0 21.3 20.7 20.1 19.6 19.2 18.8 18.3 39 23.0 22.0 21.2 20.5 20.0 19.5 19.1 18.7 18.3 17.9
  45  1   103 125 42 25.5 23.1 21.7 20.5 19.6 18.8 18.1 17.4 16.8 16.2 43  0.0  0.0 22.5 20.5 19.3 18.4 17.7 17.1 16.4 15.9
  46  1   103 125 42 25.5 23.1 21.7 20.5 19.6 18.8 18.1 17.4 16.8 16.2 43  0.0  0.0 22.5 20.5 19.3 18.4 17.7 17.1 16.4 15.9
  47  1   206 115 43  0.0  0.0 22.5 20.5 19.3 18.4 17.7 17.1 16.4 15.9 43  0.0  0.0 22.5 20.5 19.3 18.4 17.7 17.1 16.4 15.9
  48  1   206 115 43  0.0  0.0 22.5 20.5 19.3 18.4 17.7 17.1 16.4 15.9 43  0.0  0.0 22.5 20.5 19.3 18.4 17.7 17.1 16.4 15.9
  49  1   103 135 43  0.0  0.0 22.5 20.5 19.3 18.4 17.7 17.1 16.4 15.9 43  0.0  0.0 22.5 20.5 19.3 18.4 17.7 17.1 16.4 15.9
  50  1   103 135 43  0.0  0.0 22.5 20.5 19.3 18.4 17.7 17.1 16.4 15.9 43  0.0  0.0 22.5 20.5 19.3 18.4 17.7 17.1 16.4 15.9
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                     23.576 21.946 21.024 20.270 19.682 19.184 18.738 18.328 17.922 17.506

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114  2   54  65 49 24.9 23.5 22.2 21.1 20.1 19.1 18.3 17.5 16.8 16.1 50 22.7 21.2 20.0 18.9 18.0 17.2 16.6 16.0 15.4 14.9
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                    22.113 20.787 20.360 19.317 18.846 17.802 17.610 16.985 16.423 15.841

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167  3   59   5 54 30.9 25.8 24.2 23.3 22.6 22.1 21.7 21.3 21.0 20.6 54 30.9 25.8 24.2 23.3 22.6 22.1 21.7 21.3 21.0 20.6
168  3   59   5 54 30.9 25.8 24.2 23.3 22.6 22.1 21.7 21.3 21.0 20.6 54 30.9 25.8 24.2 23.3 22.6 22.1 21.7 21.3 21.0 20.6
169  3   59  95 58 20.9 19.7 18.8 18.1 17.4 16.8 16.2 15.5 14.8 13.8 59 20.4 19.3 18.5 17.8 17.1 16.6 16.0 15.3 14.6 13.7
170  3   59  95 58 20.9 19.7 18.8 18.1 17.4 16.8 16.2 15.5 14.8 13.8 59 20.4 19.3 18.5 17.8 17.1 16.6 16.0 15.3 14.6 13.7
171  3   59   5 59 20.4 19.3 18.5 17.8 17.1 16.6 16.0 15.3 14.6 13.7 59 20.4 19.3 18.5 17.8 17.1 16.6 16.0 15.3 14.6 13.7
172  3   59   5 59 20.4 19.3 18.5 17.8 17.1 16.6 16.0 15.3 14.6 13.7 59 20.4 19.3 18.5 17.8 17.1 16.6 16.0 15.3 14.6 13.7
       2586 142     24.981 22.944 21.848 21.830 20.772 20.073 19.485 18.874 18.316 17.730
                    22.826 21.092 20.211 19.417 18.787 18.288 17.798 17.354 16.908 16.440

173  4   62  35  2  0.0  0.0  0.0 26.1 25.8 24.5 23.4 22.8 21.8 21.1 16 22.8 21.5 20.6 19.8 19.4 19.0 18.6 18.2 17.8 17.4
174  4   62  35  2  0.0  0.0  0.0 26.1 25.8 24.5 23.4 22.8 21.8 21.1 16 22.8 21.5 20.6 19.8 19.4 19.0 18.6 18.2 17.8 17.4
175  4  124 105 22 29.1 25.9 24.3 23.2 22.3 21.6 20.9 20.3 19.8 19.2 28 24.3 22.7 21.6 20.9 20.3 19.7 19.2 18.8 18.3 17.9
176  4  124 105 22 29.1 25.9 24.3 23.2 22.3 21.6 20.9 20.3 19.8 19.2 28 24.3 22.7 21.6 20.9 20.3 19.7 19.2 18.8 18.3 17.9
177  4   62 125 31 23.0 22.1 21.3 20.7 20.2 19.7 19.3 18.9 18.5 18.0 28 24.3 22.7 21.6 20.9 20.3 19.7 19.2 18.8 18.3 17.9
178  4   62 125 31 23.0 22.1 21.3 20.7 20.2 19.7 19.3 18.9 18.5 18.0 28 24.3 22.7 21.6 20.9 20.3 19.7 19.2 18.8 18.3 17.9
179  4   62 205 41 25.9 24.3 23.3 22.5 21.8 21.2 20.7 20.2 19.7 19.2 43  0.0  0.0 22.5 20.5 19.3 18.4 17.7 17.1 16.4 15.9
180  4   62 205 41 25.9 24.3 23.3 22.5 21.8 21.2 20.7 20.2 19.7 19.2 43  0.0  0.0 22.5 20.5 19.3 18.4 17.7 17.1 16.4 15.9
181  4   62 205 42 25.5 23.1 21.7 20.5 19.6 18.8 18.1 17.4 16.8 16.2 43  0.0  0.0 22.5 20.5 19.3 18.4 17.7 17.1 16.4 15.9
182  4   62 205 42 25.5 23.1 21.7 20.5 19.6 18.8 18.1 17.4 16.8 16.2 43  0.0  0.0 22.5 20.5 19.3 18.4 17.7 17.1 16.4 15.9
183  4  186 125 43  0.0  0.0 22.5 20.5 19.3 18.4 17.7 17.1 16.4 15.9 43  0.0  0.0 22.5 20.5 19.3 18.4 17.7 17.1 16.4 15.9
184  4  186 125 43  0.0  0.0 22.5 20.5 19.3 18.4 17.7 17.1 16.4 15.9 43  0.0  0.0 22.5 20.5 19.3 18.4 17.7 17.1 16.4 15.9
185  4   62 205 43  0.0  0.0 22.5 20.5 19.3 18.4 17.7 17.1 16.4 15.9 43  0.0  0.0 22.5 20.5 19.3 18.4 17.7 17.1 16.4 15.9
186  4   62 205 43  0.0  0.0 22.5 20.5 19.3 18.4 17.7 17.1 16.4 15.9 43  0.0  0.0 22.5 20.5 19.3 18.4 17.7 17.1 16.4 15.9
187  4   62 205 44  0.0  0.0  0.0  0.0  0.0  0.0 27.9 23.7 21.8 20.4 44  0.0  0.0  0.0  0.0  0.0  0.0 27.9 23.7 21.8 20.4
188  4   62 205 44  0.0  0.0  0.0  0.0  0.0  0.0 27.9 23.7 21.8 20.4 44  0.0  0.0  0.0  0.0  0.0  0.0 27.9 23.7 21.8 20.4
189  4  186  35 46 23.5 21.9 20.8 19.9 19.1 18.4 17.8 17.3 16.7 16.1 47 21.2 19.9 18.9 18.1 17.5 16.9 16.5 16.0 15.6 15.2
190  4  186  35 46 23.5 21.9 20.8 19.9 19.1 18.4 17.8 17.3 16.7 16.1 47 21.2 19.9 18.9 18.1 17.5 16.9 16.5 16.0 15.6 15.2
191  4  186 115 46 23.5 21.9 20.8 19.9 19.1 18.4 17.8 17.3 16.7 16.1 47 21.2 19.9 18.9 18.1 17.5 16.9 16.5 16.0 15.6 15.2
192  4  186 115 46 23.5 21.9 20.8 19.9 19.1 18.4 17.8 17.3 16.7 16.1 47 21.2 19.9 18.9 18.1 17.5 16.9 16.5 16.0 15.6 15.2
193  4  186 125 46 23.5 21.9 20.8 19.9 19.1 18.4 17.8 17.3 16.7 16.1 47 21.2 19.9 18.9 18.1 17.5 16.9 16.5 16.0 15.6 15.2
194  4  186 125 46 23.5 21.9 20.8 19.9 19.1 18.4 17.8 17.3 16.7 16.1 47 21.2 19.9 18.9 18.1 17.5 16.9 16.5 16.0 15.6 15.2
195  4   62 205 46 23.5 21.9 20.8 19.9 19.1 18.4 17.8 17.3 16.7 16.1 47 21.2 19.9 18.9 18.1 17.5 16.9 16.5 16.0 15.6 15.2
196  4   62 205 46 23.5 21.9 20.8 19.9 19.1 18.4 17.8 17.3 16.7 16.1 47 21.2 19.9 18.9 18.1 17.5 16.9 16.5 16.0 15.6 15.2
197  4   62  95 49 24.9 23.5 22.2 21.1 20.1 19.1 18.3 17.5 16.8 16.1 50 22.7 21.2 20.0 18.9 18.0 17.2 16.6 16.0 15.4 14.9
198  4   62  95 49 24.9 23.5 22.2 21.1 20.1 19.1 18.3 17.5 16.8 16.1 50 22.7 21.2 20.0 18.9 18.0 17.2 16.6 16.0 15.4 14.9
199  4   62 205 55 22.9 22.2 21.6 20.9 20.5 20.1 19.7 19.3 19.0 18.6 55 22.9 22.2 21.6 20.9 20.5 20.1 19.7 19.3 19.0 18.6
200  4   62 205 55 22.9 22.2 21.6 20.9 20.5 20.1 19.7 19.3 19.0 18.6 55 22.9 22.2 21.6 20.9 20.5 20.1 19.7 19.3 19.0 18.6
201  4   62  75 58 20.9 19.7 18.8 18.1 17.4 16.8 16.2 15.5 14.8 13.8 59 20.4 19.3 18.5 17.8 17.1 16.6 16.0 15.3 14.6 13.7
202  4   62  75 58 20.9 19.7 18.8 18.1 17.4 16.8 16.2 15.5 14.8 13.8 59 20.4 19.3 18.5 17.8 17.1 16.6 16.0 15.3 14.6 13.7
203  4   62  95 58 20.9 19.7 18.8 18.1 17.4 16.8 16.2 15.5 14.8 13.8 59 20.4 19.3 18.5 17.8 17.1 16.6 16.0 15.3 14.6 13.7
204  4   62  95 58 20.9 19.7 18.8 18.1 17.4 16.8 16.2 15.5 14.8 13.8 59 20.4 19.3 18.5 17.8 17.1 16.6 16.0 15.3 14.6 13.7
205  4  124 125 58 20.9 19.7 18.8 18.1 17.4 16.8 16.2 15.5 14.8 13.8 59 20.4 19.3 18.5 17.8 17.1 16.6 16.0 15.3 14.6 13.7
206  4  124 125 58 20.9 19.7 18.8 18.1 17.4 16.8 16.2 15.5 14.8 13.8 59 20.4 19.3 18.5 17.8 17.1 16.6 16.0 15.3 14.6 13.7
       3348 122     23.777 22.144 21.258 20.507 19.843 19.018 18.634 17.882 17.244 16.592
                    21.736 20.436 20.184 19.123 18.371 17.749 17.599 16.949 16.379 15.802

207  5  130  95 41 25.1 23.5 22.5 21.7 21.1 20.5 20.0 19.4 18.9 18.4 43  0.0  0.0 21.7 19.7 18.5 17.7 16.9 16.3 15.7 15.1
208  5  130  95 41 25.1 23.5 22.5 21.7 21.1 20.5 20.0 19.4 18.9 18.4 43  0.0  0.0 21.7 19.7 18.5 17.7 16.9 16.3 15.7 15.1
209  5   65  95 49 24.2 22.6 21.5 20.3 19.3 18.4 17.5 16.8 16.0 15.3 50 22.0 20.5 19.2 18.1 17.2 16.5 15.8 15.2 14.6 14.1
210  5   65  95 49 24.2 22.6 21.5 20.3 19.3 18.4 17.5 16.8 16.0 15.3 50 22.0 20.5 19.2 18.1 17.2 16.5 15.8 15.2 14.6 14.1
        390  95     24.799 23.273 22.181 21.270 20.470 19.772 19.143 18.542 17.961 17.377
                    21.984 20.480 20.862 19.196 18.102 17.267 16.558 15.933 15.341 14.772

211  6   60  65 22 26.3 25.1 23.5 22.4 21.6 20.8 20.2 19.6 19.0 18.5 28 23.5 21.9 20.9 20.1 19.5 19.0 18.5 18.0 17.6 17.1
212  6   60  65 22 26.3 25.1 23.5 22.4 21.6 20.8 20.2 19.6 19.0 18.5 28 23.5 21.9 20.9 20.1 19.5 19.0 18.5 18.0 17.6 17.1
213  6  120  85 42 24.8 22.4 20.9 19.8 18.8 18.0 17.3 16.7 16.0 15.4 43  0.0  0.0 21.7 19.7 18.5 17.7 16.9 16.3 15.7 15.1
214  6  120  85 42 24.8 22.4 20.9 19.8 18.8 18.0 17.3 16.7 16.0 15.4 43  0.0  0.0 21.7 19.7 18.5 17.7 16.9 16.3 15.7 15.1
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215  6  180  65 43  0.0  0.0 21.7 19.7 18.5 17.7 16.9 16.3 15.7 15.1 43  0.0  0.0 21.7 19.7 18.5 17.7 16.9 16.3 15.7 15.1
216  6  180  65 43  0.0  0.0 21.7 19.7 18.5 17.7 16.9 16.3 15.7 15.1 43  0.0  0.0 21.7 19.7 18.5 17.7 16.9 16.3 15.7 15.1
217  6   80 205 44  0.0  0.0  0.0  0.0  0.0  0.0 27.2 22.9 21.0 19.6 44  0.0  0.0  0.0  0.0  0.0  0.0 27.2 22.9 21.0 19.6
218  6   80 205 44  0.0  0.0  0.0  0.0  0.0  0.0 27.2 22.9 21.0 19.6 44  0.0  0.0  0.0  0.0  0.0  0.0 27.2 22.9 21.0 19.6
         640  65    25.950 23.289 21.726 20.180 19.143 18.307 18.880 17.615 17.026 16.319
                    23.524 21.819 21.557 19.796 18.696 17.871 18.616 17.489 16.722 16.042

219  7   59 205 41 25.1 23.5 22.5 21.7 21.1 20.5 20.0 19.4 18.9 18.4 43  0.0  0.0 21.7 19.7 18.5 17.7 16.9 16.3 15.7 15.1
220  7   59 205 41 25.1 23.5 22.5 21.7 21.1 20.5 20.0 19.4 18.9 18.4 43  0.0  0.0 21.7 19.7 18.5 17.7 16.9 16.3 15.7 15.1
221  7   59 205 46 22.8 21.2 20.0 19.1 18.4 17.7 17.1 16.5 15.9 15.4 47 20.4 19.1 18.1 17.3 16.7 16.2 15.7 15.3 14.9 14.4
222  7   59 205 46 22.8 21.2 20.0 19.1 18.4 17.7 17.1 16.5 15.9 15.4 47 20.4 19.1 18.1 17.3 16.7 16.2 15.7 15.3 14.9 14.4
223  7   59 105 49 24.2 22.6 21.5 20.3 19.3 18.4 17.5 16.8 16.0 15.3 50 22.0 20.5 19.2 18.1 17.2 16.5 15.8 15.2 14.6 14.1
224  7   59 105 49 24.2 22.6 21.5 20.3 19.3 18.4 17.5 16.8 16.0 15.3 50 22.0 20.5 19.2 18.1 17.2 16.5 15.8 15.2 14.6 14.1
225  7   59 205 57 20.8 19.6 18.9 18.2 17.6 17.0 16.4 15.7 15.0 14.0 60 18.2 17.4 16.9 16.4 15.9 15.4 14.9 14.2 13.5 12.6
226  7   59 205 57 20.8 19.6 18.9 18.2 17.6 17.0 16.4 15.7 15.0 14.0 60 18.2 17.4 16.9 16.4 15.9 15.4 14.9 14.2 13.5 12.6
         472 180    23.289 21.808 20.732 19.454 19.075 18.381 17.727 17.096 16.458 15.773
                    20.194 19.004 18.873 17.887 17.083 16.415 15.828 15.280 14.685 14.085

227  8   58 205  7 23.2 22.2 21.4 20.8 20.2 19.8 19.3 18.9 18.5 18.0 16 22.1 20.7 19.8 19.2 18.7 18.2 17.8 17.5 17.1 16.7
228  8   58 205  7 23.2 22.2 21.4 20.8 20.2 19.8 19.3 18.9 18.5 18.0 16 22.1 20.7 19.8 19.2 18.7 18.2 17.8 17.5 17.1 16.7
229  8   58 205  8 24.5 22.9 21.7 20.8 20.1 19.5 19.0 18.5 18.0 17.6 16 22.1 20.7 19.8 19.2 18.7 18.2 17.8 17.5 17.1 16.7
230  8   58 205  8 24.5 22.9 21.7 20.8 20.1 19.5 19.0 18.5 18.0 17.6 16 22.1 20.7 19.8 19.2 18.7 18.2 17.8 17.5 17.1 16.7
231  8   58 105 14 21.6 20.8 20.2 19.8 19.3 19.0 18.6 18.2 17.9 17.5 16 22.1 20.7 19.8 19.2 18.7 18.2 17.8 17.5 17.1 16.7
232  8   58 105 14 21.6 20.8 20.2 19.8 19.3 19.0 18.6 18.2 17.9 17.5 16 22.1 20.7 19.8 19.2 18.7 18.2 17.8 17.5 17.1 16.7
233  8   58 205 18  0.0  0.0  0.0  0.0 31.6 25.4 23.8 22.4 21.5 20.7 28 23.5 21.9 20.9 20.1 19.5 19.0 18.5 18.0 17.6 17.1
234  8   58 205 18  0.0  0.0  0.0  0.0 31.6 25.4 23.8 22.4 21.5 20.7 28 23.5 21.9 20.9 20.1 19.5 19.0 18.5 18.0 17.6 17.1
235  8   58 105 32 22.2 20.9 20.1 19.5 18.9 18.4 18.0 17.6 17.2 16.7 28 23.5 21.9 20.9 20.1 19.5 19.0 18.5 18.0 17.6 17.1
236  8   58 105 32 22.2 20.9 20.1 19.5 18.9 18.4 18.0 17.6 17.2 16.7 28 23.5 21.9 20.9 20.1 19.5 19.0 18.5 18.0 17.6 17.1
237  8   58 205 38 26.4 25.1 24.1 23.2 22.4 21.7 21.1 20.5 20.0 19.4 39 22.2 21.2 20.4 19.8 19.2 18.8 18.4 18.0 17.6 17.1
238  8   58 205 38 26.4 25.1 24.1 23.2 22.4 21.7 21.1 20.5 20.0 19.4 39 22.2 21.2 20.4 19.8 19.2 18.8 18.4 18.0 17.6 17.1
239  8   58 205 46 22.8 21.2 20.0 19.1 18.4 17.7 17.1 16.5 15.9 15.4 47 20.4 19.1 18.1 17.3 16.7 16.2 15.7 15.3 14.9 14.4
240  8   58 205 46 22.8 21.2 20.0 19.1 18.4 17.7 17.1 16.5 15.9 15.4 47 20.4 19.1 18.1 17.3 16.7 16.2 15.7 15.3 14.9 14.4
241  8   58 105 49 24.2 22.6 21.5 20.3 19.3 18.4 17.5 16.8 16.0 15.3 50 22.0 20.5 19.2 18.1 17.2 16.5 15.8 15.2 14.6 14.1
242  8   58 105 49 24.2 22.6 21.5 20.3 19.3 18.4 17.5 16.8 16.0 15.3 50 22.0 20.5 19.2 18.1 17.2 16.5 15.8 15.2 14.6 14.1
243  8   58 205 49 24.2 22.6 21.5 20.3 19.3 18.4 17.5 16.8 16.0 15.3 50 22.0 20.5 19.2 18.1 17.2 16.5 15.8 15.2 14.6 14.1
244  8   58 205 49 24.2 22.6 21.5 20.3 19.3 18.4 17.5 16.8 16.0 15.3 50 22.0 20.5 19.2 18.1 17.2 16.5 15.8 15.2 14.6 14.1
245  8   58 205 52 30.9 26.6 25.2 24.2 23.3 22.7 22.1 21.7 21.3 21.0 52 30.9 26.6 25.2 24.2 23.3 22.7 22.1 21.7 21.3 21.0
246  8   58 205 52 30.9 26.6 25.2 24.2 23.3 22.7 22.1 21.7 21.3 21.0 52 30.9 26.6 25.2 24.2 23.3 22.7 22.1 21.7 21.3 21.0
247  8  118 105 57 20.8 19.6 18.9 18.2 17.6 17.0 16.4 15.7 15.0 14.0 60 18.2 17.4 16.9 16.4 15.9 15.4 14.9 14.2 13.5 12.6
248  8  118 105 57 20.8 19.6 18.9 18.2 17.6 17.0 16.4 15.7 15.0 14.0 60 18.2 17.4 16.9 16.4 15.9 15.4 14.9 14.2 13.5 12.6
249  8   58 205 57 20.8 19.6 18.9 18.2 17.6 17.0 16.4 15.7 15.0 14.0 60 18.2 17.4 16.9 16.4 15.9 15.4 14.9 14.2 13.5 12.6
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251  8   58  95 58 20.1 19.0 18.0 17.3 16.7 16.0 15.4 14.7 14.0 13.0 59 19.7 18.5 17.7 17.0 16.4 15.8 15.2 14.6 13.8 12.9
252  8   58  95 58 20.1 19.0 18.0 17.3 16.7 16.0 15.4 14.7 14.0 13.0 59 19.7 18.5 17.7 17.0 16.4 15.8 15.2 14.6 13.8 12.9
253  8  118 105 58 20.1 19.0 18.0 17.3 16.7 16.0 15.4 14.7 14.0 13.0 59 19.7 18.5 17.7 17.0 16.4 15.8 15.2 14.6 13.8 12.9
254  8  118 105 58 20.1 19.0 18.0 17.3 16.7 16.0 15.4 14.7 14.0 13.0 59 19.7 18.5 17.7 17.0 16.4 15.8 15.2 14.6 13.8 12.9
255  8   58 205 58 20.1 19.0 18.0 17.3 16.7 16.0 15.4 14.7 14.0 13.0 59 19.7 18.5 17.7 17.0 16.4 15.8 15.2 14.6 13.8 12.9
256  8   58 205 58 20.1 19.0 18.0 17.3 16.7 16.0 15.4 14.7 14.0 13.0 59 19.7 18.5 17.7 17.0 16.4 15.8 15.2 14.6 13.8 12.9
        1972 157    22.867 21.280 20.293 19.481 19.552 18.698 17.922 17.288 16.686 15.843
                    21.410 20.028 19.110 18.382 17.758 17.208 16.885 16.182 15.808 14.972

259  9   59  95 14 21.6 20.8 20.2 19.8 19.3 19.0 18.6 18.2 17.9 17.5 16 22.1 20.7 19.8 19.2 18.7 18.2 17.8 17.5 17.1 16.7
260  9   59  95 14 21.6 20.8 20.2 19.8 19.3 19.0 18.6 18.2 17.9 17.5 16 22.1 20.7 19.8 19.2 18.7 18.2 17.8 17.5 17.1 16.7
261  9   59  95 18  0.0  0.0  0.0  0.0 31.6 25.4 23.8 22.4 21.5 20.7 28 23.5 21.9 20.9 20.1 19.5 19.0 18.5 18.0 17.6 17.1
262  9   59  95 18  0.0  0.0  0.0  0.0 31.6 25.4 23.8 22.4 21.5 20.7 28 23.5 21.9 20.9 20.1 19.5 19.0 18.5 18.0 17.6 17.1
263  9   59  95 38 23.2 22.1 21.2 20.5 19.9 19.4 18.9 18.4 18.0 17.6 39 22.2 21.2 20.4 19.8 19.2 18.8 18.4 18.0 17.6 17.1
264  9   59  95 38 23.2 22.1 21.2 20.5 19.9 19.4 18.9 18.4 18.0 17.6 39 22.2 21.2 20.4 19.8 19.2 18.8 18.4 18.0 17.6 17.1
265  9   59 205 41 25.1 23.5 22.5 21.7 21.1 20.5 20.0 19.4 18.9 18.4 43  0.0  0.0 21.7 19.7 18.5 17.7 16.9 16.3 15.7 15.1
266  9   59 205 41 25.1 23.5 22.5 21.7 21.1 20.5 20.0 19.4 18.9 18.4 43  0.0  0.0 21.7 19.7 18.5 17.7 16.9 16.3 15.7 15.1
267  9   59  95 42 24.8 22.4 20.9 19.8 18.8 18.0 17.3 16.7 16.0 15.4 43  0.0  0.0 21.7 19.7 18.5 17.7 16.9 16.3 15.7 15.1
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268  9   59  95 42 24.8 22.4 20.9 19.8 18.8 18.0 17.3 16.7 16.0 15.4 43  0.0  0.0 21.7 19.7 18.5 17.7 16.9 16.3 15.7 15.1
269  9   59 105 42 24.8 22.4 20.9 19.8 18.8 18.0 17.3 16.7 16.0 15.4 43  0.0  0.0 21.7 19.7 18.5 17.7 16.9 16.3 15.7 15.1
270  9   59 105 42 24.8 22.4 20.9 19.8 18.8 18.0 17.3 16.7 16.0 15.4 43  0.0  0.0 21.7 19.7 18.5 17.7 16.9 16.3 15.7 15.1
271  9  118 205 42 24.8 22.4 20.9 19.8 18.8 18.0 17.3 16.7 16.0 15.4 43  0.0  0.0 21.7 19.7 18.5 17.7 16.9 16.3 15.7 15.1
272  9  118 205 42 24.8 22.4 20.9 19.8 18.8 18.0 17.3 16.7 16.0 15.4 43  0.0  0.0 21.7 19.7 18.5 17.7 16.9 16.3 15.7 15.1
273  9  118  95 43  0.0  0.0 21.7 19.7 18.5 17.7 16.9 16.3 15.7 15.1 43  0.0  0.0 21.7 19.7 18.5 17.7 16.9 16.3 15.7 15.1
274  9  118  95 43  0.0  0.0 21.7 19.7 18.5 17.7 16.9 16.3 15.7 15.1 43  0.0  0.0 21.7 19.7 18.5 17.7 16.9 16.3 15.7 15.1
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         5844   24      23.763  22.142  21.101  20.277  19.601  19.010  18.480  17.988  17.504  17.021
                        23.221  21.654  20.481  19.677  19.028  18.472  17.962  17.528  17.087  16.640

355  13    63  205  21  26.6  25.4  24.5  23.6  23.1  22.5  22.0  21.5  21.0  20.5  28  24.3  22.7  21.6  20.9  20.3  19.7  19.2  18.8  18.3  17.9
356  13    63  205  21  26.6  25.4  24.5  23.6  23.1  22.5  22.0  21.5  21.0  20.5  28  24.3  22.7  21.6  20.9  20.3  19.7  19.2  18.8  18.3  17.9
386  13   126  205  42  25.5  23.1  21.7  20.5  19.6  18.8  18.1  17.4  16.8  16.2  43   0.0   0.0  22.5  20.5  19.3  18.4  17.7  17.1  16.6  15.9
385  13   126  205  42  25.5  23.1  21.7  20.5  19.6  18.8  18.1  17.4  16.8  16.2  43   0.0   0.0  22.5  20.5  19.3  18.4  17.7  17.1  16.6  15.9
374  13   126  205  46  23.5  21.9  20.6  19.9  19.1  18.4  17.8  17.3  16.7  16.1  47  21.2  19.9  18.6  18.1  17.5  16.9  16.5  16.0  15.6  15.2
373  13   126  205  46  23.5  21.9  20.6  19.9  19.1  18.4  17.8  17.3  16.7  16.1  47  21.2  19.9  18.6  18.1  17.5  16.9  16.5  16.0  15.6  15.2
369  13   126  205  54  30.9  25.8  24.2  23.3  22.6  22.1  21.7  21.3  21.0  20.6  54  30.9  25.8  24.2  23.3  22.6  22.1  21.7  21.3  21.0  20.6
368  13   126  205  54  30.9  25.8  24.2  23.3  22.6  22.1  21.7  21.3  21.0  20.6  54  30.9  25.8  24.2  23.3  22.6  22.1  21.7  21.3  21.0  20.6
          882  205      26.641  23.887  22.649  21.583  20.817  20.157  19.581  19.083  18.573  18.081
                        25.670  22.610  21.616  20.646  19.853  19.217  18.656  18.226  17.780  17.288

399  14   180    5  27  23.6  22.6  22.0  21.3  20.6  20.3  19.8  19.3  18.9  18.4  28  24.3  22.7  21.6  20.9  20.3  19.7  19.2  18.8  18.3  17.9
400  14   180    5  27  23.6  22.6  22.0  21.3  20.6  20.3  19.8  19.3  18.9  18.4  28  24.3  22.7  21.6  20.9  20.3  19.7  19.2  18.8  18.3  17.9
415  14   240    5  46  23.5  21.9  20.6  19.9  19.1  18.4  17.8  17.3  16.7  16.1  47  21.2  19.9  18.6  18.1  17.5  16.9  16.5  16.0  15.6  15.2
416  14   240    5  46  23.5  21.9  20.6  19.9  19.1  18.4  17.8  17.3  16.7  16.1  47  21.2  19.9  18.6  18.1  17.5  16.9  16.5  16.0  15.6  15.2
394  14    60   15  16  22.7  21.6  20.6  20.1  19.6  19.2  18.7  18.4  18.0  17.6  16  22.6  21.5  20.6  19.9  19.4  19.0  18.6  18.2  17.8  17.4
393  14    60   15  16  22.7  21.6  20.6  20.1  19.6  19.2  18.7  18.4  18.0  17.6  16  22.6  21.5  20.6  19.9  19.4  19.0  18.6  18.2  17.8  17.4
401  14   120   15  27  23.6  22.6  22.0  21.3  20.6  20.3  19.8  19.3  18.9  18.4  28  24.3  22.7  21.6  20.9  20.3  19.7  19.2  18.8  18.3  17.9
402  14   120   15  27  23.6  22.6  22.0  21.3  20.6  20.3  19.8  19.3  18.9  18.4  28  24.3  22.7  21.6  20.9  20.3  19.7  19.2  18.8  18.3  17.9
404  14   120   15  28  24.3  22.7  21.6  20.9  20.3  19.7  19.2  18.8  18.3  17.9  28  24.3  22.7  21.6  20.9  20.3  19.7  19.2  18.8  18.3  17.9
403  14   120   15  28  24.3  22.7  21.6  20.9  20.3  19.7  19.2  18.8  18.3  17.9  28  24.3  22.7  21.6  20.9  20.3  19.7  19.2  18.8  18.3  17.9
410  14   180   15  38  23.9  22.6  22.0  21.3  20.7  20.1  19.6  19.2  18.8  18.3  38  23.0  22.0  21.2  20.5  20.0  19.5  19.1  18.7  18.3  17.9
409  14   180   15  38  23.9  22.6  22.0  21.3  20.7  20.1  19.6  19.2  18.8  18.3  38  23.0  22.0  21.2  20.5  20.0  19.5  19.1  18.7  18.3  17.9
418  14   240   15  46  23.5  21.9  20.6  19.9  19.1  18.4  17.8  17.3  16.7  16.1  47  21.2  19.9  18.6  18.1  17.5  16.9  16.5  16.0  15.6  15.2
417  14   240   15  46  23.5  21.9  20.6  19.9  19.1  18.4  17.8  17.3  16.7  16.1  47  21.2  19.9  18.6  18.1  17.5  16.9  16.5  16.0  15.6  15.2
432  14   180   15  50  22.7  21.2  20.0  18.9  18.0  17.2  16.6  16.0  15.4  14.9  50  22.7  21.2  20.0  18.9  18.0  17.2  16.6  16.0  15.4  14.9
431  14   180   15  50  22.7  21.2  20.0  18.9  18.0  17.2  16.6  16.0  15.4  14.9  50  22.7  21.2  20.0  18.9  18.0  17.2  16.6  16.0  15.4  14.9
438  14    60   15  52  31.6  27.5  26.0  24.9  24.1  23.5  22.9  22.5  22.1  21.7  52  31.6  27.5  26.0  24.9  24.1  23.5  22.9  22.5  22.1  21.7
437  14    60   15  52  31.6  27.5  26.0  24.9  24.1  23.5  22.9  22.5  22.1  21.7  52  31.6  27.5  26.0  24.9  24.1  23.5  22.9  22.5  22.1  21.7
449  14   200   15  59  20.4  19.3  18.5  17.8  17.1  16.6  16.0  15.3  14.8  13.7  59  20.4  19.3  18.5  17.8  17.1  16.6  16.0  15.3  14.8  13.7
450  14   200   15  59  20.4  19.3  18.5  17.8  17.1  16.6  16.0  15.3  14.8  13.7  59  20.4  19.3  18.5  17.8  17.1  16.6  16.0  15.3  14.8  13.7
395  14   180   25  16  22.7  21.6  20.6  20.1  19.6  19.2  18.7  18.4  18.0  17.6  16  22.6  21.5  20.6  19.9  19.4  19.0  18.6  18.2  17.8  17.4
396  14   180   25  16  22.7  21.6  20.6  20.1  19.6  19.2  18.7  18.4  18.0  17.6  16  22.6  21.5  20.6  19.9  19.4  19.0  18.6  18.2  17.8  17.4
406  14   180   25  28  24.3  22.7  21.6  20.9  20.3  19.7  19.2  18.8  18.3  17.9  28  24.3  22.7  21.6  20.9  20.3  19.7  19.2  18.8  18.3  17.9
405  14   180   25  28  24.3  22.7  21.6  20.9  20.3  19.7  19.2  18.8  18.3  17.9  28  24.3  22.7  21.6  20.9  20.3  19.7  19.2  18.8  18.3  17.9
414  14    60   25  43   0.0   0.0  22.5  20.5  19.3  18.4  17.7  17.1  16.4  15.9  43   0.0   0.0  22.5  20.5  19.3  18.4  17.7  17.1  16.6  15.9
413  14    60   25  43   0.0   0.0  22.5  20.5  19.3  18.4  17.7  17.1  16.4  15.9  43   0.0   0.0  22.5  20.5  19.3  18.4  17.7  17.1  16.6  15.9
420  14   600   25  46  23.5  21.9  20.6  19.9  19.1  18.4  17.8  17.3  16.7  16.1  47  21.2  19.9  18.6  18.1  17.5  16.9  16.5  16.0  15.6  15.2
419  14   600   25  46  23.5  21.9  20.6  19.9  19.1  18.4  17.8  17.3  16.7  16.1  47  21.2  19.9  18.6  18.1  17.5  16.9  16.5  16.0  15.6  15.2
433  14   180   25  50  22.7  21.2  20.0  18.9  18.0  17.2  16.6  16.0  15.4  14.9  50  22.7  21.2  20.0  18.9  18.0  17.2  16.6  16.0  15.4  14.9
434  14   180   25  50  22.7  21.2  20.0  18.9  18.0  17.2  16.6  16.0  15.4  14.9  50  22.7  21.2  20.0  18.9  18.0  17.2  16.6  16.0  15.4  14.9
441  14   180   25  54  30.9  25.8  24.2  23.3  22.6  22.1  21.7  21.3  21.0  20.6  54  30.9  25.8  24.2  23.3  22.6  22.1  21.7  21.3  21.0  20.6
442  14   180   25  54  30.9  25.8  24.2  23.3  22.6  22.1  21.7  21.3  21.0  20.6  54  30.9  25.8  24.2  23.3  22.6  22.1  21.7  21.3  21.0  20.6
443  14    60   25  55  22.9  22.2  21.6  20.9  20.5  20.1  19.7  19.3  19.0  18.6  55  22.9  22.2  21.6  20.9  20.5  20.1  19.7  19.3  19.0  18.6
444  14    60   25  55  22.9  22.2  21.6  20.9  20.5  20.1  19.7  19.3  19.0  18.6  55  22.9  22.2  21.6  20.9  20.5  20.1  19.7  19.3  19.0  18.6
452  14   120   25  59  20.4  19.3  18.5  17.8  17.1  16.6  16.0  15.3  14.8  13.7  59  20.4  19.3  18.5  17.8  17.1  16.6  16.0  15.3  14.8  13.7
451  14   120   25  59  20.4  19.3  18.5  17.8  17.1  16.6  16.0  15.3  14.8  13.7  59  20.4  19.3  18.5  17.8  17.1  16.6  16.0  15.3  14.8  13.7
408  14    60   35  28  24.3  22.7  21.6  20.9  20.3  19.7  19.2  18.8  18.3  17.9  28  24.3  22.7  21.6  20.9  20.3  19.7  19.2  18.8  18.3  17.9
407  14    60   35  28  24.3  22.7  21.6  20.9  20.3  19.7  19.2  18.8  18.3  17.9  28  24.3  22.7  21.6  20.9  20.3  19.7  19.2  18.8  18.3  17.9
422  14   120   35  46  23.5  21.9  20.6  19.9  19.1  18.4  17.8  17.3  16.7  16.1  47  21.2  19.9  18.6  18.1  17.5  16.9  16.5  16.0  15.6  15.2
421  14   120   35  46  23.5  21.9  20.6  19.9  19.1  18.4  17.8  17.3  16.7  16.1  47  21.2  19.9  18.6  18.1  17.5  16.9  16.5  16.0  15.6  15.2
435  14    60   35  50  22.7  21.2  20.0  18.9  18.0  17.2  16.6  16.0  15.4  14.9  50  22.7  21.2  20.0  18.9  18.0  17.2  16.6  16.0  15.4  14.9
436  14    60   35  50  22.7  21.2  20.0  18.9  18.0  17.2  16.6  16.0  15.4  14.9  50  22.7  21.2  20.0  18.9  18.0  17.2  16.6  16.0  15.4  14.9
         8880   19      22.834  21.886  20.865  20.113  19.595  18.796  18.230  17.712  17.188  16.646
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					22.808	21.215	20.232	19.402	18.836	18.167	17.685	17.213	16.741	16.245											
423	14	80	95	46	23.5	21.9	20.6	19.9	19.1	18.4	17.8	17.3	16.7	16.1	47	21.2	19.9	18.9	18.1	17.5	16.9	16.5	16.0	15.6	15.2
424	14	80	95	46	23.5	21.9	20.6	19.9	19.1	18.4	17.8	17.3	16.7	16.1	47	21.2	19.9	18.9	18.1	17.5	16.9	16.5	16.0	15.6	15.2
427	14	80	95	49	24.9	23.5	22.2	21.1	20.1	19.1	18.3	17.5	16.8	16.1	50	22.7	21.2	20.0	18.9	18.0	17.2	16.6	16.0	15.4	14.9
428	14	80	95	49	24.9	23.5	22.2	21.1	20.1	19.1	18.3	17.5	16.8	16.1	50	22.7	21.2	20.0	18.9	18.0	17.2	16.6	16.0	15.4	14.9
381	14	80	105	14	22.4	21.6	21.0	20.5	20.1	19.7	19.3	19.0	18.6	18.2	16	22.8	21.5	20.6	19.9	19.4	19.0	18.6	18.2	17.8	17.4
382	14	80	105	14	22.4	21.6	21.0	20.5	20.1	19.7	19.3	19.0	18.6	18.2	16	22.8	21.5	20.6	19.9	19.4	19.0	18.6	18.2	17.8	17.4
387	14	80	105	15	22.7	21.6	20.8	20.1	19.6	19.2	18.7	18.4	18.0	17.6	16	22.8	21.5	20.6	19.9	19.4	19.0	18.6	18.2	17.8	17.4
388	14	80	105	15	22.7	21.6	20.8	20.1	0.0	19.2	18.7	18.4	18.0	17.6	16	22.8	21.5	20.6	19.9	19.4	19.0	18.6	18.2	17.8	17.4
429	14	80	105	49	24.9	23.5	22.2	21.1	20.1	19.1	18.3	17.5	16.8	16.1	50	22.7	21.2	20.0	18.9	18.0	17.2	16.6	16.0	15.4	14.9
430	14	80	105	49	24.9	23.5	22.2	21.1	20.1	19.1	18.3	17.5	16.8	16.1	50	22.7	21.2	20.0	18.9	18.0	17.2	16.6	16.0	15.4	14.9
439	14	80	105	52	31.6	27.5	26.0	24.9	24.1	23.5	22.9	22.5	22.1	21.7	52	31.6	27.5	26.0	24.9	24.1	23.5	22.9	22.5	22.1	21.7
440	14	80	105	52	31.6	27.5	26.0	24.9	24.1	23.5	22.9	22.5	22.1	21.7	52	31.6	27.5	26.0	24.9	24.1	23.5	22.9	22.5	22.1	21.7
447	14	80	105	57	21.5	20.5	19.7	19.0	18.4	17.8	17.1	16.5	15.7	14.8	60	19.0	18.2	17.7	17.1	16.6	16.1	15.6	15.0	14.3	13.4
448	14	80	105	57	21.5	20.5	19.7	19.0	18.4	17.8	17.1	16.5	15.7	14.8	60	19.0	18.2	17.7	17.1	16.6	16.1	15.6	15.0	14.3	13.4
611	14	120	205	42	25.5	23.1	21.7	20.5	19.6	18.8	18.1	17.4	16.8	16.2	43	0.0	0.0	22.5	20.5	19.3	18.4	17.7	17.1	16.4	15.9
612	14	120	205	42	25.5	23.1	21.7	20.5	19.6	18.8	18.1	17.4	16.8	16.2	43	0.0	0.0	22.5	20.5	19.3	18.4	17.7	17.1	16.4	15.9
425	14	120	205	46	23.5	21.9	20.6	19.9	19.1	18.4	17.8	17.3	16.7	16.1	47	21.2	19.9	18.9	18.1	17.5	16.9	16.5	16.0	15.6	15.2
426	14	120	205	46	23.5	21.9	20.6	19.9	19.1	18.4	17.8	17.3	16.7	16.1	47	21.2	19.9	18.9	18.1	17.5	16.9	16.5	16.0	15.6	15.2
445	14	80	205	55	22.9	22.2	21.6	20.9	20.5	20.1	19.7	19.3	19.0	18.6	55	22.9	22.2	21.6	20.9	20.5	20.1	19.7	19.3	19.0	18.6
446	14	80	205	55	22.9	22.2	21.6	20.9	20.5	20.1	19.7	19.3	19.0	18.6	55	22.9	22.2	21.6	20.9	20.5	20.1	19.7	19.3	19.0	18.6
		1440	145		24.390	22.709	21.583	20.680	19.853	19.276	18.688	18.100	17.547	16.983											
					22.819	21.290	20.853	19.651	18.918	18.309	17.775	17.284	16.801	16.306											
457	15	672	95	5	26.9	26.1	24.6	23.5	22.7	22.0	21.3	20.8	20.2	19.7	16	23.8	22.2	21.4	20.7	20.2	19.7	19.3	19.0	18.6	18.2
458	15	672	95	5	26.9	26.1	24.6	23.5	22.7	22.0	21.3	20.8	20.2	19.7	16	23.8	22.2	21.4	20.7	20.2	19.7	19.3	19.0	18.6	18.2
459	15	112	125	5	26.9	26.1	24.6	23.5	22.7	22.0	21.3	20.8	20.2	19.7	16	23.8	22.2	21.4	20.7	20.2	19.7	19.3	19.0	18.6	18.2
460	15	112	125	5	26.9	26.1	24.6	23.5	22.7	22.0	21.3	20.8	20.2	19.7	16	23.8	22.2	21.4	20.7	20.2	19.7	19.3	19.0	18.6	18.2
461	15	168	95	10	25.4	24.5	23.6	23.0	22.4	21.8	21.3	20.9	20.4	19.9	16	23.8	22.2	21.4	20.7	20.2	19.7	19.3	19.0	18.6	18.2
462	15	168	95	10	25.4	24.5	23.6	23.0	22.4	21.8	21.3	20.9	20.4	19.9	16	23.8	22.2	21.4	20.7	20.2	19.7	19.3	19.0	18.6	18.2
463	15	168	95	14	23.2	22.4	21.8	21.3	20.8	20.5	20.1	19.7	19.4	19.0	16	23.8	22.2	21.4	20.7	20.2	19.7	19.3	19.0	18.6	18.2
464	15	168	95	14	23.2	22.4	21.8	21.3	20.8	20.5	20.1	19.7	19.4	19.0	16	23.8	22.2	21.4	20.7	20.2	19.7	19.3	19.0	18.6	18.2
465	15	56	115	14	23.2	22.4	21.8	21.3	20.8	20.5	20.1	19.7	19.4	19.0	16	23.8	22.2	21.4	20.7	20.2	19.7	19.3	19.0	18.6	18.2
466	15	56	115	14	23.2	22.4	21.8	21.3	20.8	20.5	20.1	19.7	19.4	19.0	16	23.8	22.2	21.4	20.7	20.2	19.7	19.3	19.0	18.6	18.2
467	15	392	95	15	23.6	22.3	21.5	20.9	20.4	19.9	19.5	19.1	18.7	18.3	16	23.8	22.2	21.4	20.7	20.2	19.7	19.3	19.0	18.6	18.2
468	15	392	95	15	23.6	22.3	21.5	20.9	20.4	19.9	19.5	19.1	18.7	18.3	16	23.8	22.2	21.4	20.7	20.2	19.7	19.3	19.0	18.6	18.2
469	15	56	205	17	0.0	0.0	0.0	0.0	0.0	34.7	29.0	26.9	25.7	24.6	17	0.0	0.0	0.0	0.0	0.0	34.7	29.0	26.9	25.7	24.6
470	15	56	205	17	0.0	0.0	0.0	0.0	0.0	34.7	29.0	26.9	25.7	24.6	17	0.0	0.0	0.0	0.0	0.0	34.7	29.0	26.9	25.7	24.6
471	15	56	95	22	29.9	26.6	25.0	23.9	23.1	22.4	21.7	21.1	20.5	20.0	26	25.0	23.4	22.4	21.6	21.0	20.5	20.0	19.5	19.1	18.7
472	15	56	95	22	29.9	26.6	25.0	23.9	23.1	22.4	21.7	21.1	20.5	20.0	26	25.0	23.4	22.4	21.6	21.0	20.5	20.0	19.5	19.1	18.7
473	15	56	105	22	29.9	26.6	25.0	23.9	23.1	22.4	21.7	21.1	20.5	20.0	26	25.0	23.4	22.4	21.6	21.0	20.5	20.0	19.5	19.1	18.7
474	15	56	105	22	29.9	26.6	25.0	23.9	23.1	22.4	21.7	21.1	20.5	20.0	26	25.0	23.4	22.4	21.6	21.0	20.5	20.0	19.5	19.1	18.7
475	15	56	205	23	25.5	24.4	23.5	22.8	22.2	21.6	21.1	20.6	20.2	19.7	26	25.0	23.4	22.4	21.6	21.0	20.5	20.0	19.5	19.1	18.7
476	15	56	205	23	25.5	24.4	23.5	22.8	22.2	21.6	21.1	20.6	20.2	19.7	26	25.0	23.4	22.4	21.6	21.0	20.5	20.0	19.5	19.1	18.7
477	15	56	95	30	24.7	23.6	23.0	22.4	21.9	21.5	21.0	20.6	20.2	19.8	26	25.0	23.4	22.4	21.6	21.0	20.5	20.0	19.5	19.1	18.7
478	15	56	95	30	24.7	23.6	23.0	22.4	21.9	21.5	21.0	20.6	20.2	19.8	26	25.0	23.4	22.4	21.6	21.0	20.5	20.0	19.5	19.1	18.7
479	15	112	95	31	23.7	22.6	22.1	21.5	21.0	20.5	20.1	19.6	19.2	18.8	26	25.0	23.4	22.4	21.6	21.0	20.5	20.0	19.5	19.1	18.7
480	15	112	95	31	23.7	22.6	22.1	21.5	21.0	20.5	20.1	19.6	19.2	18.8	26	25.0	23.4	22.4	21.6	21.0	20.5	20.0	19.5	19.1	18.7
481	15	56	95	32	23.7	22.5	21.8	21.0	20.4	20.0	19.5	19.1	18.7	18.3	26	25.0	23.4	22.4	21.6	21.0	20.5	20.0	19.5	19.1	18.7
482	15	56	95	32	23.7	22.5	21.8	21.0	20.4	20.0	19.5	19.1	18.7	18.3	26	25.0	23.4	22.4	21.6	21.0	20.5	20.0	19.5	19.1	18.7
483	15	56	95	35	29.3	27.9	26.7	25.8	25.1	24.4	23.8	23.3	22.7	22.2	39	23.7	22.7	21.9	21.3	20.8	20.3	19.9	19.5	19.1	18.7
484	15	56	95	35	29.3	27.9	26.7	25.8	25.1	24.4	23.8	23.3	22.7	22.2	39	23.7	22.7	21.9	21.3	20.8	20.3	19.9	19.5	19.1	18.7
485	15	56	95	36	27.9	26.6	25.6	24.7	23.9	23.3	22.6	22.0	21.5	20.9	39	23.7	22.7	21.9	21.3	20.8	20.3	19.9	19.5	19.1	18.7
486	15	56	95	36	27.9	26.6	25.6	24.7	23.9	23.3	22.6	22.0	21.5	20.9	39	23.7	22.7	21.9	21.3	20.8	20.3	19.9	19.5	19.1	18.7
487	15	112	95	37	25.9	24.8	24.0	23.3	22.6	22.3	21.8	21.4	21.0	20.6	39	23.7	22.7	21.9	21.3	20.8	20.3	19.9	19.5	19.1	18.7
488	15	112	95	37	25.9	24.8	24.0	23.3	22.6	22.3	21.8	21.4	21.0	20.6	39	23.7	22.7	21.9	21.3	20.8	20.3	19.9	19.5	19.1	18.7
489	15	56	95	38	24.7	23.6	22.7	22.0	21.4	20.9	20.4	20.0	19.5	19.1	39	23.7	22.7	21.9	21.3	20.8	20.3	19.9	19.5	19.1	18.7
490	15	56	95	38	24.7	23.6	22.7	22.0	21.4	20.9	20.4	20.0	19.5	19.1	39	23.7	22.7	21.9	21.3	20.8	20.3	19.9	19.5	19.1	18.7
491	15	56	95	38	24.7	23.6	22.7	22.0	21.4	20.9	20.4	20.0	19.5	19.1	39	23.7	22.7	21.9	21.3	20.8	20.3	19.9	19.5	19.1	18.7

492	15	56	95	38	24.7	23.6	22.7	22.0	21.4	20.9	20.4	20.0	19.5	19.1	39	23.7	22.7	21.9	21.3	20.8	20.3	19.9	19.5	19.1	18.7
493	15	56	125	41	26.6	25.0	24.0	23.3	22.6	22.0	21.5	21.0	20.5	19.9	43	0.0	0.0	23.2	21.3	20.1	19.2	18.5	17.8	17.2	16.6
494	15	56	125	41	26.6	25.0	24.0	23.3	22.6	22.0	21.5	21.0	20.5	19.9	43	0.0	0.0	23.2	21.3	20.1	19.2	18.5	17.8	17.2	16.6
495	15	56	95	46	24.3	22.7	21.5	20.6	19.9	19.2	18.6	18.0	17.4	16.9	47	21.9	20.6	19.6	18.8	18.2	17.7	17.2	16.8	16.4	15.9
496	15	56	95	46	24.3	22.7	21.5	20.6	19.9	19.2	18.6	18.0	17.4	16.9	47	21.9	20.6	19.6	18.8	18.2	17.7	17.2	16.8	16.4	15.9
497	15	56	125	46	24.3	22.7	21.5	20.6	19.9	19.2	18.6	18.0	17.4	16.9	47	21.9	20.6	19.6	18.8	18.2	17.7	17.2	16.8	16.4	15.9
498	15	56	125	46	24.3	22.7	21.5	20.6	19.9	19.2	18.6	18.0	17.4	16.9	47	21.9	20.6	19.6	18.8	18.2	17.7	17.2	16.8	16.4	15.9
499	15	112	95	52	32.4	28.3	26.6	25.7	24.9	24.2	23.7	23.2	22.9	22.5	52	32.4	28.3	26.6	25.7	24.9	24.2	23.7	23.2	22.9	22.5
500	15	112	95	52	32.4	28.3	26.6	25.7	24.9	24.2	23.7	23.2	22.9	22.5	52	32.4	28.3	26.6	25.7	24.9	24.2	23.7	23.2	22.9	22.5
501	15	112	95	54	31.6	26.6	25.0	24.0	23.4	22.8	22.4	22.1	21.8	21.5	54	31.6	26.6	25.0	24.0	23.4	22.8	22.4	22.1	21.8	21.5
502	15	112	95	54	31.6	26.6	25.0	24.0	23.4	22.8	22.4	22.1	21.8	21.5	54	31.6	26.6	25.0	24.0	23.4	22.8	22.4	22.1	21.8	21.5
503	15	56	95	55	23.7	22.9	22.3	21.8	21.2	20.8	20.4	20.1	19.7	19.4	55	23.7	22.9	22.3	21.8	21.2	20.8	20.4	20.1	19.7	19.4
504	15	56	95	55	23.7	22.9	22.3	21.8	21.2	20.8	20.4	20.1	19.7	19.4	55	23.7	22.9	22.3	21.8	21.2	20.8	20.4	20.1	19.7	19.4
505	15	168	95	58	21.6	20.5	19.6	18.8	18.2	17.6	17.0	16.3	15.5	14.6	58	21.2	20.1	19.2	18.5	17.9	17.3	16.7	16.1	15.3	14.4
506	15	168	95	58	21.6	20.5	19.6	18.8	18.2	17.6	17.0	16.3	15.5	14.6	58	21.2	20.1	19.2	18.5	17.9	17.3	16.7	16.1	15.3	14.4
		5936	100		26.316	24.422	23.316	22.481	21.824	21.501	20.886	20.386	19.880	19.380											
					24.205	22.680	21.772	21.081	20.481	20.271	19.730	19.288	18.858	18.419											
527	16	118	6	27	23.6	22.6	22.0	21.3	20.8	20.3	19.8	19.3	18.9	18.4	28	24.3	22.7	21.6	20.9	20.3	19.7	19.2	18.8	18.3	17.9
528	16	118	6	27	23.6	22.6	22.0	21.3	20.8	20.3	19.8	19.3	18.9	18.4	28	24.3	22.7	21.6	20.9	20.3	19.7	19.2	18.8	18.3	17.9
547	16	56	6	46	23.5	21.9	20.6	19.9	19.1	18.4	17.8	17.3	16.7	16.1	47	21.2	19.9	18.9	18.1	17.5	16.9	16.5	16.0	15.6	15.2
548	16	56	6	46	23.5	21.9	20.6	19.9	19.1	18.4	17.8	17.3	16.7	16.1	47	21.2	19.9	18.9	18.1	17.5	16.9	16.5	16.0	15.6	15.2
515	16	118	15	14	22.4	21.6	21.0	20.5	20.1	19.7	19.3	19.0	18.6	18.2	16	22.8	21.5	20.6	19.9	19.4	19.0	18.6	18.2	17.8	17.4
516	16	118	15	14	22.4	21.6	21.0	20.5	20.1	19.7	19.3	19.0	18.6	18.2	16	22.8	21.5	20.6	19.9	19.4	19.0	18.6	18.2	17.8	17.4
517	16	56	15	15	22.7	21.6	20.8	20.1	19.6	19.2	18.7	18.4	18.0	17.6	16	22.8	21.5	20.6	19.9	19.4	19.0	18.6	18.2	17.8	17.4
518	16	56	15	15	22.7	21.6	20.8	20.1	19.6	19.2	18.7	18.4	18.0	17.6	16	22.8	21.5	20.6	19.9	19.4	19.0	18.6	18.2	17.8	17.4
529	16	56	15	27	23.6	22.6	22.0	21.3	20.8	20.3	19.8	19.3	18.9	18.4	28	24.3	22.7	21.6	20.9	20.3	19.7	19.2	18.8	18.3	17.9
530	16	56	15	27	23.6	22.6	22.0	21.3	20.8	20.3	19.8	19.3	18.9	18.4	28	24.3	22.7	21.6	20.9	20.3	19.7	19.2	18.8	18.3	17.9
534	16	232	15	28	24.3	22.7	21.6	20.9	20.3	19.7	19.2	18.8	18.3	17.9	28	24.3	22.7	21.6	20.9	20.3	19.7	19.2	18.8	18.3	17.9
533	16	232	15	28	24.3	22.7	21.6	20.9	20.3	19.7	19.2	18.8	18.3	17.9	28	24.3	22.7	21.6	20.9	20.3	19.7	19.2	18.8	18.3	17.9
536	16	56	15	29	24.2	22.8	21.9	21.1	20.4	19.8	19.3	18.8	18.3	17.9	28	24.3	22.7	21.6	20.9	20.3	19.7	19.2	18.8	18.3	17.9
537	16	56	15	29	24.2	22.8	21.9	21.1	20.4	19.8	19.3	18.8	18.3	17.9	28	24.3	22.7	21.6	20.9	20.3	19.7	19.2	18.8	18.3	17.9
539	16	118	15	36	23.9	22.8	22.0	21.3	20.7	20.1	19.6	19.2	18.8	18.3	38	23.0	22.0	21.2	20.5	20.0	19.5	19.1	18.7	18.3	17.9
540	16	118	15	36	23.9	22.8	22.0	21.3	20.7	20.1	19.6	19.2	18.8	18.3	38	23.0	22.0	21.2	20.5	20.0	19.5	19.1	18.7	18.3	17.9
549	16	56	15	46	23.5	21.9	20.6	19.9	19.1	18.4	17.8	17.3	16.7	16.1	47	21.2	19.9	18.9	18.1	17.5	16.9	16.5	16.0	15.6	15.2
550	16	56	15	46	23.5	21.9	20.6	19.9	19.1	18.4	17.8	17.3	16.7	16.1	47	21.2	19.9	18.9	18.1	17.5	16.9	16.5	16.0	15.6	15.2
555	16	56	15	50	22.7	21.2	20.0	18.9	18.0	17.2	16.6	16.0	15.4	14.9	50	22.7	21.2	20.0	18.9	18.0	17.2	16.6	16.0	15.4	14.9
556	16	56	15	50	22.7	21.2	20.0	18.9	18.0	17.2	16.6	16.0	15.4	14.9	50	22.7	21.2	20.0	18.9	18.0	17.2	16.6	16.0	15.4	14.9
520	16	280	25	15	22.7	21.6	20.8	20.1	19.6	19.2	18.7	18.4	18.0	17.6	16	22.8	21.5	20.6	19.9	19.4	19.0	18.6	18.2	17.8	17.4
519	16	280	25	15	22.7	21.6	20.8	20.1	19.6	19.2	18.7	18.4	18.0	17.6	16	22.8	21.5	20.6	19.9	19.4	19.0	18.6	18.2	17.8	17.4
532	16	56	25	27	23.6	22.6	22.0	21.3	20.8	20.3	19.8	19.3	18.9	18.4	28	24.3	22.7	21.6	20.9	20.3	19.7	19.2	18.8	18.3	17.9
531	16	56	25	27	23.6	22.6	22.0	21.3	20.8	20.3	19.8	19.3	18.9	18.4	28	24.3	22.7	21.6	20.9	20.3	19.7	19.2	18.8	18.3	17.9
535	16	522	25	28	24.3	22.7	21.6	20.9	20.3	19.7	19.2	18.8	18.3	17.9	28	24.3	22.7	21.6	20.9	20.3	19.7	19.2	18.8	18.3	17.9
538	16	522	25	28	24.3	22.7	21.6	20.9	20.3	19.7	19.2	18.8	18.3	17.9	28	24.3	22.7	21.6	20.9	20.3	19.7	19.2	18.8	18.3	17.9
541	16	56	25	36	23.9	22.8	22.0	21.3	20.7	20.1	19.6	19.2	18.8	18.3	38	23.0	22.0	21.2	20.5	20.0	19.5	19.1	18.7	18.3	17.9
542	16	56	25	36	23.9	22.8	22.0	21.3	20.7	20.1	19.6	19.2	18.8	18.3	38	23.0	22.0	21.2	20.5	20.0	19.5	19.1	18.7	18.3	17.9
551	16	280	25	46	23.5	21.9	20.6	19.9	19.1	18.4	17.8	17.3	16.7	16.1	47	21.2	19.9	18.9	18.1	17.5	16.9	16.5	16.0	15.6	15.2
552	16	280	25	46	23.5	21.9	20.6	19.9	19.1	18.4	17.8	17.3	16.7	16.1	47	21.2	19.9	18.9	18.1	17.5	16.9	16.5	16.0	15.6	15.2
544	16	56	35	36	23.9	22.8	22.0	21.3	20.7	20.1	19.6	19.2	18.8	18.3	38	23.0	22.0	21.2	20.5	20.0	19.5	19.1	18.7	18.3	17.9
543	16	56	35	36	23.9	22.8	22.0	21.3	20.7	20.1	19.6	19.2	18.8	18.3	38	23.0	22.0	21.2	20.5	20.0	19.5	19.1	18.7	18.3	17.9
561	16	56	35	54	30.9	25.8	24.2	23.3	22.6	22.1	21.7	21.3	21.0	20.6	54	30.9	25.8	24.2	23.3	22.6	22.1	21.7	21.3	21.0	20.6
562	16	56	35	54	30.9	25.8	24.2	23.3	22.6	22.1	21.7	21.3	21.0	20.6	54	30.9	25.8	24.2	23.3	22.6	22.1	21.7	21.3	21.0	20.6
545	16	56	65	43	0.0	0.0	22.5	20.5	19.3	18.4	17.7	17.1	16.4	15.9	43	0.0	0.0	22.5	20.5	19.3	18.4	17.7	17.1	16.4	15.9
546	16	56	65	43	0.0	0.0	22.5	20.5	19.3	18.4	17.7	17.1	16.4	15.9	43	0.0	0.0	22.5	20.5	19.3	18.4	17.7	17.1	16.4	15.9
		4640	21		23.643	22.368	21.443	20.685	20.028	19.477	18.977	18.510	18.055	17.583											
					23.420	21.697	20.961	20.171	19.561	19.037	18.568	18.135	17.711	17.277											
563	16	56	125	54	30.9	25.8	24.2	23.3	22.6	22.1	21.7	21.3	21.0	20.6	54	30.9	25.8	24.2	23.3	22.6	22.1	21.7	21.3	21.0	20.6
564	16	56	125	54	30.9	25.8	24.2	23.3	22.6	22.1	21.7	21.3	21.0	20.6	54	30.9	25.8	24.2	23.3	22.6	22.1	21.7	21.3	21.0	20.6
513	16	56	205	2	0.0	0.0	0.0	26.1	25.6	24.8	23.4	22.6	21.8	21.1	16	22.8	21.5	20.6	19.9	19.4	19.0	18.6	18.2	17.8	17.4

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650 19    62 205 30 24.7 23.8 23.0 22.4 21.8 21.5 21.0 20.6 20.2 19.8 28 25.0 23.4 22.4 21.6 21.0 20.5 20.0 19.5 19.1 18.7
649 19    62 205 30 24.7 23.8 23.0 22.4 21.8 21.5 21.0 20.6 20.2 19.8 28 25.0 23.4 22.4 21.6 21.0 20.5 20.0 19.5 19.1 18.7
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676 19    62 205 52 32.4 28.3 26.8 25.7 24.9 24.2 23.7 23.2 22.9 22.5 52 32.4 28.3 26.8 25.7 24.9 24.2 23.7 23.2 22.9 22.5
677 19    62 205 53  0.0  0.0 35.2 31.5 29.7 28.6 27.8 26.9 26.4 25.9 53  0.0  0.0 35.2 31.5 29.7 28.6 27.8 26.9 26.4 25.9
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681 19    62 205 55 23.7 22.9 22.3 21.6 21.2 20.8 20.4 20.1 19.7 19.4 55 23.7 22.9 22.3 21.6 21.2 20.8 20.4 20.1 19.7 19.4
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       4464 136       25.121 23.988 23.204 22.284 21.924 21.189 20.650 20.158 19.691 19.226
                      24.149 22.875 22.180 21.334 20.726 20.220 19.784 19.348 18.941 18.527

683 20    58  25 27 23.8 22.8 22.0 21.3 20.8 20.3 19.8 19.3 18.9 18.4 28 24.3 22.7 21.8 20.9 20.3 19.7 19.2 18.8 18.3 17.9
684 20    58  25 27 23.8 22.8 22.0 21.3 20.8 20.3 19.8 19.3 18.9 18.4 28 24.3 22.7 21.8 20.9 20.3 19.7 19.2 18.8 18.3 17.9
685 20    58 105 31 23.0 22.1 21.3 20.7 20.2 19.7 19.3 18.9 18.5 18.0 28 24.3 22.7 21.8 20.9 20.3 19.7 19.2 18.8 18.3 17.9
686 20    58 105 31 23.0 22.1 21.3 20.7 20.2 19.7 19.3 18.9 18.5 18.0 28 24.3 22.7 21.8 20.9 20.3 19.7 19.2 18.8 18.3 17.9
687 20    58  25 38 23.9 22.8 22.0 21.3 20.7 20.1 19.6 19.2 18.8 18.3 39 23.0 22.0 21.2 20.5 20.0 19.5 19.1 18.7 18.3 17.9
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718 21   126  85 38 24.7 23.6 22.7 22.0 21.4 20.9 20.4 20.0 19.5 19.1 38 23.7 22.7 21.9 21.3 20.8 20.3 19.9 19.5 19.1 18.7
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720 21   441 105 38 24.7 23.6 22.7 22.0 21.4 20.9 20.4 20.0 19.5 19.1 38 23.7 22.7 21.9 21.3 20.8 20.3 19.9 19.5 19.1 18.7
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       3276 106       25.208 23.810 22.577 21.781 21.105 20.518 19.982 19.480 18.988 18.481
                      24.151 22.845 21.744 20.888 20.344 19.613 19.327 18.888 18.448 17.887

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744 22    60 105  2  0.0  0.0  0.0 26.8 26.8 25.2 24.2 23.3 22.8 21.9 18 23.6 22.2 21.4 20.7 20.2 19.7 19.3 19.0 18.6 18.2
745 22   540 105  5 28.9 26.1 24.6 23.5 22.7 22.0 21.3 20.8 20.2 19.7 18 23.6 22.2 21.4 20.7 20.2 19.7 19.3 19.0 18.6 18.2
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757 22   300 105 22 29.9 26.6 25.0 23.9 23.1 22.4 21.7 21.1 20.5 20.0 28 25.0 23.4 22.4 21.6 21.0 20.5 20.0 19.5 19.1 18.7
758 22   300 105 22 29.9 26.6 25.0 23.9 23.1 22.4 21.7 21.1 20.5 20.0 28 25.0 23.4 22.4 21.6 21.0 20.5 20.0 19.5 19.1 18.7
759 22   180 125 22 29.9 26.6 25.0 23.9 23.1 22.4 21.7 21.1 20.5 20.0 28 25.0 23.4 22.4 21.6 21.0 20.5 20.0 19.5 19.1 18.7
760 22   180 125 22 29.9 26.6 25.0 23.9 23.1 22.4 21.7 21.1 20.5 20.0 28 25.0 23.4 22.4 21.6 21.0 20.5 20.0 19.5 19.1 18.7
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762 22   180 105 31 23.7 22.8 22.1 21.5 21.0 20.5 20.1 19.6 19.2 18.8 28 25.0 23.4 22.4 21.6 21.0 20.5 20.0 19.5 19.1 18.7
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765 22   120 125 32 23.7 22.5 21.6 21.0 20.4 20.0 19.5 19.1 18.7 18.3 28 25.0 23.4 22.4 21.6 21.0 20.5 20.0 19.5 19.1 18.7
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       8480 109       25.402 23.911 22.810 22.108 21.448 20.881 20.380 19.923 19.486 18.998
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793 23   57  15 16 22.8 21.5 20.8 19.9 19.4 19.0 18.6 18.2 17.8 17.6 16 22.8 21.5 20.8 19.9 19.4 19.0 18.6 18.2 17.8 17.6
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820 23   57  15 59 20.4 19.3 18.5 17.8 17.1 16.6 16.0 15.3 14.6 13.7 59 20.4 19.3 18.5 17.8 17.1 16.6 16.0 15.3 14.6 13.7
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812 23   57  25 54 30.9 25.8 24.2 23.3 22.6 22.1 21.7 21.3 21.0 20.8 54 30.9 25.8 24.2 23.3 22.6 22.1 21.7 21.3 21.0 20.8
        684  18    24.440 22.467 21.421 20.670 20.080 19.535 19.057 18.602 18.148 17.686
                   24.278 22.317 21.288 20.547 19.951 19.434 18.969 18.520 18.074 17.698

806 23   57  95 46 23.5 21.9 20.8 19.9 19.1 18.4 17.8 17.3 16.7 16.1 47 21.2 19.9 18.9 18.1 17.5 16.9 16.5 16.0 15.6 15.2
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800 23   57 125 31 23.0 22.1 21.3 20.7 20.2 19.7 19.3 18.9 18.5 18.0 26 24.3 22.7 21.6 20.9 20.3 19.7 19.2 18.8 18.3 17.9
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        252  85.   24.301 23.408 22.708 22.118 21.602 21.142 20.707 20.287 19.887 19.483
                   23.800 22.241 21.384 20.707 20.181 19.748 19.348 18.974 18.598 18.207

857 26   63 105  2  0.0  0.0  0.0 28.6 26.8 25.2 24.2 23.3 22.6 21.9 16 23.6 22.2 21.4 20.7 20.2 19.7 19.3 19.0 18.6 18.2
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873 26  126 105 18  0.0  0.0  0.0  0.0 33.1 27.0 25.1 23.9 23.0 22.2 26 25.0 23.4 22.4 21.6 21.0 20.5 20.0 19.5 19.1 18.7
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1025 28    64  205 58 20.9 19.7 18.8 18.1 17.4 16.8 16.2 15.5 14.8 13.8 58 20.4 19.3 18.5 17.8 17.1 16.8 16.0 15.3 14.6 13.7
1026 28    64  205 58 20.9 19.7 18.8 18.1 17.4 16.8 16.2 15.5 14.8 13.8 58 20.4 19.3 18.5 17.8 17.1 16.8 16.0 15.3 14.6 13.7
         5984  109    24.489 22.935 22.004 21.306 20.480 19.817 19.202 18.616 18.042 17.428
                      23.081 21.802 21.145 20.303 19.493 18.902 18.355 17.640 17.320 16.773

1033 29    70  105  5 28.1 25.4 23.8 22.7 21.9 21.2 20.8 20.0 19.5 18.9 16 22.8 21.5 20.8 19.8 19.4 19.0 18.8 18.2 17.8 17.6
1034 29    70  105  5 28.1 25.4 23.8 22.7 21.9 21.2 20.8 20.0 19.5 18.9 16 22.8 21.5 20.8 19.8 19.4 19.0 18.8 18.2 17.8 17.6
1035 29    70  115  5 28.1 25.4 23.8 22.7 21.9 21.2 20.8 20.0 19.5 18.9 16 22.8 21.5 20.8 19.8 19.4 19.0 18.8 18.2 17.8 17.6
1036 29    70  115  5 28.1 25.4 23.8 22.7 21.9 21.2 20.8 20.0 19.5 18.9 16 22.8 21.5 20.8 19.8 19.4 19.0 18.8 18.2 17.8 17.6
1037 29   140  105 14 22.4 21.6 21.0 20.5 20.1 19.7 19.3 19.0 18.8 18.3 16 22.8 21.5 20.8 19.8 19.4 19.0 18.8 18.2 17.8 17.6
1038 29   140  105 14 22.4 21.6 21.0 20.5 20.1 19.7 19.3 19.0 18.8 18.3 16 22.8 21.5 20.8 19.8 19.4 19.0 18.8 18.2 17.8 17.6
1039 29   210  115 14 22.4 21.6 21.0 20.5 20.1 19.7 19.3 19.0 18.8 18.3 16 22.8 21.5 20.8 19.8 19.4 19.0 18.8 18.2 17.8 17.6
1040 29   210  115 14 22.4 21.6 21.0 20.5 20.1 19.7 19.3 19.0 18.8 18.3 16 22.8 21.5 20.8 19.8 19.4 19.0 18.8 18.2 17.8 17.6
1041 29   140  105 15 22.7 21.6 20.8 20.1 19.6 19.2 18.7 18.4 18.0 17.8 16 22.8 21.5 20.8 19.8 19.4 19.0 18.8 18.2 17.8 17.6
1042 29   140  105 15 22.7 21.6 20.8 20.1 19.6 19.2 18.7 18.4 18.0 17.8 16 22.8 21.5 20.8 19.8 19.4 19.0 18.8 18.2 17.8 17.6
1043 29   140  115 15 22.7 21.6 20.8 20.1 19.6 19.2 18.7 18.4 18.0 17.8 16 22.8 21.5 20.8 19.8 19.4 19.0 18.8 18.2 17.8 17.6
1044 29   140  115 15 22.7 21.6 20.8 20.1 19.6 19.2 18.7 18.4 18.0 17.8 16 22.8 21.5 20.8 19.8 19.4 19.0 18.8 18.2 17.8 17.6
1045 29    70  105 18  0.0  0.0  0.0  0.0 32.3 26.2 24.4 23.2 22.3 21.5 28 24.3 22.7 21.6 20.9 20.3 19.7 19.2 18.6 18.3 17.9
1046 29    70  105 18  0.0  0.0  0.0  0.0 32.3 26.2 24.4 23.2 22.3 21.5 28 24.3 22.7 21.6 20.9 20.3 19.7 19.2 18.6 18.3 17.9
1047 29   140  115 18  0.0  0.0  0.0  0.0 32.3 26.2 24.4 23.2 22.3 21.5 28 24.3 22.7 21.6 20.9 20.3 19.7 19.2 18.6 18.3 17.9
1048 29   140  115 18  0.0  0.0  0.0  0.0 32.3 26.2 24.4 23.2 22.3 21.5 28 24.3 22.7 21.6 20.9 20.3 19.7 19.2 18.6 18.3 17.9
1049 29   140  105 22 28.1 25.9 24.3 23.2 22.3 21.6 20.9 20.3 19.8 19.2 28 24.3 22.7 21.6 20.9 20.3 19.7 19.2 18.6 18.3 17.9
1050 29   140  105 22 28.1 25.9 24.3 23.2 22.3 21.6 20.9 20.3 19.8 19.2 28 24.3 22.7 21.6 20.9 20.3 19.7 19.2 18.6 18.3 17.9
1051 29    70  105 31 23.0 22.1 21.3 20.7 20.2 19.7 19.3 18.9 18.5 18.0 28 24.3 22.7 21.6 20.9 20.3 19.7 19.2 18.6 18.3 17.9
1052 29    70  105 31 23.0 22.1 21.3 20.7 20.2 19.7 19.3 18.9 18.5 18.0 28 24.3 22.7 21.6 20.9 20.3 19.7 19.2 18.6 18.3 17.9
1053 29    70  115 41 25.9 24.3 23.3 22.5 21.8 21.2 20.7 20.2 19.7 19.2 43  0.0  0.0 22.5 20.5 19.3 18.4 17.7 17.1 16.4 16.0
1054 29    70  115 41 25.9 24.3 23.3 22.5 21.8 21.2 20.7 20.2 19.7 19.2 43  0.0  0.0 22.5 20.5 19.3 18.4 17.7 17.1 16.4 16.0
1055 29    70  105 42 25.5 23.1 21.7 20.5 19.6 18.8 18.1 17.4 16.8 16.2 43  0.0  0.0 22.5 20.5 19.3 18.4 17.7 17.1 16.4 16.0
1056 29    70  105 42 25.5 23.1 21.7 20.5 19.6 18.8 18.1 17.4 16.8 16.2 43  0.0  0.0 22.5 20.5 19.3 18.4 17.7 17.1 16.4 16.0
1057 29    70  105 51  0.0 34.5 32.8 31.5 30.7 30.1 29.3 28.5 27.7 27.1 51  0.0 34.5 32.8 31.5 30.7 30.1 29.3 28.5 27.7 27.1
1058 29    70  105 51  0.0 34.5 32.8 31.5 30.7 30.1 29.3 28.5 27.7 27.1 51  0.0 34.5 32.8 31.5 30.7 30.1 29.3 28.5 27.7 27.1
1059 29    70  115 51  0.0 34.5 32.8 31.5 30.7 30.1 29.3 28.5 27.7 27.1 51  0.0 34.5 32.8 31.5 30.7 30.1 29.3 28.5 27.7 27.1
1060 29    70  115 51  0.0 34.5 32.8 31.5 30.7 30.1 29.3 28.5 27.7 27.1 51  0.0 34.5 32.8 31.5 30.7 30.1 29.3 28.5 27.7 27.1
1061 29    70  205 52 31.8 27.5 26.0 24.9 24.1 23.5 22.9 22.5 22.1 21.7 52 31.8 27.5 26.0 24.9 24.1 23.5 22.9 22.5 22.1 21.7
1062 29    70  205 52 31.8 27.5 26.0 24.9 24.1 23.5 22.9 22.5 22.1 21.7 52 31.8 27.5 26.0 24.9 24.1 23.5 22.9 22.5 22.1 21.7
1063 29    70  105 58 20.9 19.7 18.8 18.1 17.4 16.8 16.2 15.5 14.8 13.8 58 20.4 19.3 18.5 17.8 17.1 16.8 16.0 15.3 14.6 13.7
1064 29    70  105 58 20.9 19.7 18.8 18.1 17.4 16.8 16.2 15.5 14.8 13.8 58 20.4 19.3 18.5 17.8 17.1 16.8 16.0 15.3 14.6 13.7
         3220  113.   24.881 24.120 23.025 22.240 22.999 21.724 21.019 20.435 19.881 19.387
                      23.632 23.247 22.317 21.388 20.726 20.191 19.678 19.217 18,793 18.387

1065 30    59  105  2  0.0  0.0  0.0 28.8 26.8 25.2 24.2 23.3 22.8 21.8 16 23.8 22.3 21.4 20.7 20.2 19.7 19.3 19.0 18.8 18.3
1066 30    59  105  2  0.0  0.0  0.0 28.8 26.8 25.2 24.2 23.3 22.8 21.8 16 23.8 22.3 21.4 20.7 20.2 19.7 19.3 19.0 18.8 18.3
1067 30   354   75  3  0.0 28.7 26.7 25.2 24.1 23.2 22.5 21.8 21.3 20.8 16 23.8 22.3 21.4 20.7 20.2 19.7 19.3 19.0 18.8 18.3
1068 30   354   75  3  0.0 28.7 26.7 25.2 24.1 23.2 22.5 21.8 21.3 20.8 16 23.8 22.3 21.4 20.7 20.2 19.7 19.3 19.0 18.8 18.3
1069 30    59  105  5 26.9 26.1 24.8 23.5 22.7 22.0 21.3 20.8 20.3 19.7 16 23.8 22.3 21.4 20.7 20.2 19.7 19.3 19.0 18.8 18.3
1070 30    59  105  5 26.9 26.1 24.8 23.5 22.7 22.0 21.3 20.8 20.3 19.7 16 23.8 22.3 21.4 20.7 20.2 19.7 19.3 19.0 18.8 18.3
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1071 30   177   75 10 25.4 24.5 23.8 23.0 22.4 21.8 21.3 20.9 20.4 19.9 16 23.8 22.3 21.4 20.7 20.2 19.7 19.3 19.0 18.8 18.3
1072 30   177   75 10 25.4 24.5 23.8 23.0 22.4 21.8 21.3 20.9 20.4 19.9 16 23.8 22.3 21.4 20.7 20.2 19.7 19.3 19.0 18.8 18.3
1073 30    59  105 10 25.4 24.5 23.8 23.0 22.4 21.8 21.3 20.9 20.4 19.9 16 23.8 22.3 21.4 20.7 20.2 19.7 19.3 19.0 18.8 18.3
1074 30    59  105 10 25.4 24.5 23.8 23.0 22.4 21.8 21.3 20.9 20.4 19.9 16 23.8 22.3 21.4 20.7 20.2 19.7 19.3 19.0 18.8 18.3
1075 30   354   75 11 23.9 22.9 22.3 21.7 21.3 20.8 20.4 20.0 19.6 19.2 16 23.8 22.3 21.4 20.7 20.2 19.7 19.3 19.0 18.8 18.3
1076 30   354   75 11 23.9 22.9 22.3 21.7 21.3 20.8 20.4 20.0 19.6 19.2 16 23.8 22.3 21.4 20.7 20.2 19.7 19.3 19.0 18.8 18.3
1077 30   531   75 12 24.5 23.2 22.2 21.5 20.9 20.4 19.9 19.5 19.1 18.6 16 23.8 22.3 21.4 20.7 20.2 19.7 19.3 19.0 18.8 18.3
1078 30   531   75 12 24.5 23.2 22.2 21.5 20.9 20.4 19.9 19.5 19.1 18.6 16 23.8 22.3 21.4 20.7 20.2 19.7 19.3 19.0 18.8 18.3
1079 30   177   75 13 25.2 23.3 22.2 21.4 20.8 20.2 19.6 19.3 18.9 18.5 16 23.8 22.3 21.4 20.7 20.2 19.7 19.3 19.0 18.8 18.3
1080 30   177   75 13 25.2 23.3 22.2 21.4 20.8 20.2 19.6 19.3 18.9 18.5 16 23.8 22.3 21.4 20.7 20.2 19.7 19.3 19.0 18.8 18.3
1081 30    59   65 14 23.2 22.4 21.6 21.3 20.8 20.5 20.1 19.7 19.4 19.0 16 23.8 22.3 21.4 20.7 20.2 19.7 19.3 19.0 18.8 18.3
1082 30    59   65 14 23.2 22.4 21.6 21.3 20.8 20.5 20.1 19.7 19.4 19.0 16 23.8 22.3 21.4 20.7 20.2 19.7 19.3 19.0 18.8 18.3
1083 30    59  105 14 23.2 22.4 21.6 21.3 20.8 20.5 20.1 19.7 19.4 19.0 16 23.8 22.3 21.4 20.7 20.2 19.7 19.3 19.0 18.8 18.3
1084 30    59  105 14 23.2 22.4 21.6 21.3 20.8 20.5 20.1 19.7 19.4 19.0 16 23.8 22.3 21.4 20.7 20.2 19.7 19.3 19.0 18.8 18.3
1085 30    59  115 14 23.2 22.4 21.6 21.3 20.8 20.5 20.1 19.7 19.4 19.0 16 23.8 22.3 21.4 20.7 20.2 19.7 19.3 19.0 18.8 18.3
1086 30    59  115 14 23.2 22.4 21.6 21.3 20.8 20.5 20.1 19.7 19.4 19.0 16 23.8 22.3 21.4 20.7 20.2 19.7 19.3 19.0 18.8 18.3
1087 30   177  105 15 23.4 22.3 21.5 20.9 20.4 19.8 19.5 19.1 18.7 18.3 16 23.8 22.3 21.4 20.7 20.2 19.7 19.3 19.0 18.8 18.3
1088 30   177  105 15 23.4 22.3 21.5 20.9 20.4 19.8 19.5 19.1 18.7 18.3 16 23.8 22.3 21.4 20.7 20.2 19.7 19.3 19.0 18.8 18.3
1089 30    59  115 15 23.4 22.3 21.5 20.9 20.4 19.8 19.5 19.1 18.7 18.3 16 23.8 22.3 21.4 20.7 20.2 19.7 19.3 19.0 18.8 18.3
1090 30    59  115 15 23.4 22.3 21.5 20.9 20.4 19.8 19.5 19.1 18.7 18.3 16 23.8 22.3 21.4 20.7 20.2 19.7 19.3 19.0 18.8 18.3
1091 30    59   75 19 28.9 27.5 26.4 25.6 24.8 24.2 23.6 23.1 22.5 22.0 28 25.0 23.4 22.4 21.6 21.0 20.5 20.0 19.5 19.1 18.7
1092 30    59   75 19 28.9 27.5 26.4 25.6 24.8 24.2 23.6 23.1 22.5 22.0 28 25.0 23.4 22.4 21.6 21.0 20.5 20.0 19.5 19.1 18.7
1093 30   118   75 20  0.0 30.8 27.3 25.7 24.5 23.7 22.8 22.2 21.6 21.0 28 25.0 23.4 22.4 21.6 21.0 20.5 20.0 19.5 19.1 18.7
1094 30   118   75 20  0.0 30.8 27.3 25.7 24.5 23.7 22.8 22.2 21.6 21.0 28 25.0 23.4 22.4 21.6 21.0 20.5 20.0 19.5 19.1 18.7
1095 30    59   65 21 27.4 26.2 25.3 24.5 23.9 23.3 22.8 22.3 21.6 21.3 28 25.0 23.4 22.4 21.6 21.0 20.5 20.0 19.5 19.1 18.7
1096 30    59   65 21 27.4 26.2 25.3 24.5 23.9 23.3 22.8 22.3 21.6 21.3 28 25.0 23.4 22.4 21.6 21.0 20.5 20.0 19.5 19.1 18.7
1097 30    59   75 28 25.0 23.4 22.4 21.6 21.0 20.5 20.0 19.5 19.1 18.7 28 25.0 23.4 22.4 21.6 21.0 20.5 20.0 19.5 19.1 18.7
1098 30    59   75 28 25.0 23.4 22.4 21.6 21.0 20.5 20.0 19.5 19.1 18.7 28 25.0 23.4 22.4 21.6 21.0 20.5 20.0 19.5 19.1 18.7
1099 30    59   75 34  0.0  0.0  0.0  0.0 34.8 31.6 30.2 29.1 28.3 27.3 34  0.0  0.0  0.0  0.0 34.8 31.6 30.2 29.1 28.3 27.3
1100 30    59   75 34  0.0  0.0  0.0  0.0 34.8 31.6 30.2 29.1 28.3 27.3 34  0.0  0.0  0.0  0.0 34.8 31.6 30.2 29.1 28.3 27.3
1101 30    59   75 38 27.9 26.6 25.6 24.7 23.9 23.3 22.6 22.0 21.5 20.9 38 23.7 22.7 21.8 21.3 20.6 20.3 19.8 19.5 19.1 18.7
1102 30    59   75 38 27.9 26.6 25.6 24.7 23.9 23.3 22.6 22.0 21.5 20.9 38 23.7 22.7 21.8 21.3 20.6 20.3 19.8 19.5 19.1 18.7
1103 30    59  105 38 27.9 26.6 25.6 24.7 23.9 23.3 22.6 22.0 21.5 20.9 38 23.7 22.7 21.8 21.3 20.6 20.3 19.8 19.5 19.1 18.7
1104 30    59  105 38 27.9 26.6 25.6 24.7 23.9 23.3 22.6 22.0 21.5 20.9 38 23.7 22.7 21.8 21.3 20.6 20.3 19.8 19.5 19.1 18.7
1105 30   177  105 38 24.7 23.8 22.7 22.0 21.4 20.9 20.4 20.0 19.5 19.1 38 23.7 22.7 21.8 21.3 20.6 20.3 19.8 19.5 19.1 18.7
1106 30   177  105 38 24.7 23.8 22.7 22.0 21.4 20.9 20.4 20.0 19.5 19.1 38 23.7 22.7 21.8 21.3 20.6 20.3 19.8 19.5 19.1 18.7
1107 30    59  115 38 24.7 23.8 22.7 22.0 21.4 20.9 20.4 20.0 19.5 19.1 38 23.7 22.7 21.8 21.3 20.6 20.3 19.8 19.5 19.1 18.7
1108 30    59  115 38 24.7 23.8 22.7 22.0 21.4 20.9 20.4 20.0 19.5 19.1 38 23.7 22.7 21.8 21.3 20.6 20.3 19.8 19.5 19.1 18.7
1109 30    59  115 43  0.0  0.0 23.2 21.3 20.1 19.2 18.5 17.8 17.3 16.8 43  0.0  0.0 23.3 21.3 20.1 19.2 18.5 17.8 17.3 16.8
1110 30    59  115 43  0.0  0.0 23.2 21.3 20.1 19.2 18.5 17.8 17.3 16.8 43  0.0  0.0 23.3 21.3 20.1 19.2 18.5 17.8 17.3 16.8
1111 30    59  115 46 24.3 22.7 21.8 20.6 19.9 19.2 18.6 18.0 17.4 16.8 47 21.8 20.6 19.8 18.8 18.2 17.7 17.2 16.8 16.4 15.8
1112 30    59  115 46 24.3 22.7 21.8 20.6 19.9 19.2 18.6 18.0 17.4 16.8 47 21.8 20.6 19.8 18.8 18.2 17.7 17.2 16.8 16.4 15.8
1113 30    59  105 52 32.4 28.3 26.8 25.7 24.9 24.2 23.7 23.2 22.9 22.5 52 32.4 28.3 26.8 25.7 24.9 24.2 23.7 23.2 22.9 22.5
1114 30    59  105 52 32.4 28.3 26.8 25.7 24.9 24.2 23.7 23.2 22.9 22.5 52 32.4 28.3 26.8 25.7 24.9 24.2 23.7 23.2 22.9 22.5
1115 30    59   75 53  0.0  0.0 35.2 31.5 29.7 28.6 27.6 26.9 26.4 25.9 53  0.0  0.0 35.2 31.5 29.7 28.6 27.6 26.9 26.4 25.9
1116 30    59   75 53  0.0  0.0 35.2 31.5 29.7 28.6 27.6 26.9 26.4 25.9 53  0.0  0.0 35.2 31.5 29.7 28.6 27.6 26.9 26.4 25.9
1117 30    59   75 54 31.6 26.6 25.0 24.0 23.4 22.8 22.4 22.1 21.8 21.5 54 31.6 26.6 25.0 24.0 23.4 22.8 22.4 22.1 21.8 21.5
1118 30    59   75 54 31.6 26.6 25.0 24.0 23.4 22.8 22.4 22.1 21.8 21.5 54 31.6 26.6 25.0 24.0 23.4 22.8 22.4 22.1 21.8 21.5
1119 30    59   75 58 21.8 20.5 19.6 18.8 18.2 17.6 17.0 16.3 15.5 14.6 58 21.2 20.1 19.2 18.5 17.9 17.3 16.7 16.1 15.3 14.4
1120 30    59   75 58 21.8 20.5 19.6 18.8 18.2 17.6 17.0 16.3 15.5 14.6 58 21.2 20.1 19.2 18.5 17.9 17.3 16.7 16.1 15.3 14.4
1121 30   236  105 58 21.8 20.5 19.6 18.8 18.2 17.6 17.0 16.3 15.5 14.6 58 21.2 20.1 19.2 18.5 17.9 17.3 16.7 16.1 15.3 14.4
1122 30   236  105 58 21.8 20.5 19.6 18.8 18.2 17.6 17.0 16.3 15.5 14.6 58 21.2 20.1 19.2 18.5 17.9 17.3 16.7 16.1 15.3 14.4
1123 30    59  115 58 21.8 20.5 19.6 18.8 18.2 17.6 17.0 16.3 15.5 14.6 58 21.2 20.1 19.2 18.5 17.9 17.3 16.7 16.1 15.3 14.4
1124 30    59  115 58 21.8 20.5 19.6 18.8 18.2 17.6 17.0 16.3 15.5 14.6 58 21.2 20.1 19.2 18.5 17.9 17.3 16.7 16.1 15.3 14.4
         7080   88    24.738 24.217 23.298 22.500 21.950 21.344 20.781 20.280 19.758 19.230
                      23.750 22.318 21.673 20.927 20.586 20.053 19.565 19.150 18.713 18.284

1131 31   186  105  5 28.1 25.4 23.8 22.7 21.9 21.2 20.8 20.0 19.5 18.9 16 22.8 21.5 20.8 19.8 19.4 19.0 18.8 18.2 17.8 17.6
1132 31   186  105  5 28.1 25.4 23.8 22.7 21.9 21.2 20.8 20.0 19.5 18.9 16 22.8 21.5 20.8 19.8 19.4 19.0 18.8 18.2 17.8 17.6
1133 31    62  105  5  0.0 25.2 24.8 23.1 22.1 21.2 20.5 19.9 19.3 18.8 16 22.8 21.5 20.8 19.8 19.4 19.0 18.8 18.2 17.8 17.6
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1252 33  106  95 52 32 4 26 3 26 6 25 7 24 8 24 2 23 7 23 2 22 9 22 5 52 32 4 26 3 26 6 25 7 24 9 24 2 23 7 23 2 22 8 22 5
1253 33   53  95 54 31 6 26 8 25 0 24 0 23 4 22 8 22 4 22 1 21 8 21 5 54 31 6 26 6 25 0 24 0 23 4 22 8 22 4 22 1 21 8 21 5
1254 33   53  95 54 31 6 26 8 25 0 24 0 23 4 22 8 22 4 22 1 21 8 21 5 54 31 6 26 8 25 0 24 0 23 4 22 8 22 4 22 1 21 8 21 5
1255 33   53 115 54 31 6 26 6 25 0 24 0 23 4 22 8 22 4 22 1 21 8 21 5 54 31 6 26 6 25 0 24 0 23 4 22 8 22 4 22 1 21 8 21 5
1256 33   53 115 54 31 6 26 6 25 0 24 0 23 4 22 8 22 4 22 1 21 8 21 5 54 31 6 26 6 25 0 24 0 23 4 22 8 22 4 22 1 21 8 21 5
1257 33  854  95 58 21 6 20 5 19 6 18 8 18 2 17 6 17 0 16 3 15 5 14 6 59 21 2 20 1 19 2 18 5 17 9 17 3 16 7 16 1 15 3 14 6
1258 33  954  95 58 21 6 20 5 19 6 18 8 18 2 17 6 17 0 16 3 15 5 14 6 59 21 2 20 1 19 2 18 5 17 9 17 3 16 7 16 1 15 3 14 6
        6042 101     24 768 23 982 22 821 21 875 21 321 20 546 19 881 19 253 18 823 17 946
                     22 374 22 898 21 918 21 016 20 304 19 700 19 122 18 574 18 003 17 389
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15. Appendix VII - Stand based management units for Model 5 in working circle 1

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Stand-based management units of Working Circle 1
Based on age, site productivity, and
haul distance in 20 Km class intervals (0 - 20, 21 - 40, 41 - 60, etc)

310 number of timber classes

First column   : the identity of stand
Second column  : the identity of compartment
Third column   : the area of stand in hectares
Fourth column  : the age of stand
Fifth column   : the yield stream identity of the existing stand
Sixth column   : the yield stream identity of the regeneration stand
Seventh column : the actual haul distance

   74  2    54  205  1  1 35.3
   73  2    54  205  1  1 35.3
  174  4    62   35  2 16 30.6
  173  4    62   35  2 16 30.6
    1  1   412   95  2 16 33
    2  1   412   95  2 16 33
  842 28   192  105  2 16 38.6
  841 28   192  105  2 16 38.6
  893 27   300  105  2 16 40.3
  894 27   300  105  2 16 40.3
 1066 30    59  105  2 16 42.3
 1065 30    59  105  2 16 42.3
  856 26    63  105  2 16 48.9
  857 26    63  105  2 16 48.9
  744 22    60  105  2 16 54.4
  743 22    60  105  2 16 54.4
    3  1   103  125  2 16 33
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937	27	60	205	54	54	40.3
387	13	63	25	55	55	20.8
388	13	63	25	55	55	20.8
443	14	60	25	55	55	28.7
444	14	60	25	55	55	28.7
123	2	54	65	55	55	35.3
124	2	54	65	55	55	35.3
125	2	54	75	55	55	35.3
126	2	54	75	55	55	35.3
604	15	56	85	55	55	44.4
603	15	56	85	55	55	44.4
852	24	85	105	55	55	47.8
851	24	85	105	55	55	47.8
1016	28	84	145	55	55	38.8
1015	28	84	145	55	55	38.8
446	14	60	205	55	55	28.7
445	14	60	205	55	55	28.7
617	23	57	205	55	55	30.4
618	23	57	205	55	55	30.4
199	4	62	205	55	55	30.8
200	4	62	205	55	55	30.8
127	2	54	205	55	55	35.3
128	2	54	205	55	55	35.3
882	19	62	205	55	55	42.3
881	19	62	205	55	55	42.3
781	22	120	205	55	55	54.4
782	22	120	205	55	55	54.4
129	2	108	95	57	60	35.3
130	2	108	95	57	60	35.3
885	26	63	95	57	60	40.9
886	26	63	95	57	60	40.9
246	8	116	105	57	60	14.2
247	8	116	105	57	60	14.2
1167	31	63	105	57	60	28.3
1168	31	62	105	57	60	28.3
448	14	60	105	57	60	28.7
447	14	60	105	57	60	28.7
131	2	54	125	57	60	35.3
132	2	54	125	57	60	35.3
250	8	58	205	57	60	14.2
249	8	58	205	57	60	14.2
226	7	59	205	57	60	18.3
225	7	58	205	57	60	18.3
202	4	62	75	56	59	30.8
201	4	62	75	56	59	30.8
87	1	103	75	56	59	33
88	1	103	75	56	59	33
133	2	54	75	56	59	35.3
134	2	54	75	56	59	35.3
1119	30	58	75	56	59	42.3
1120	30	59	75	56	59	42.3
251	8	58	85	56	59	14.2
252	8	58	85	56	59	14.2
282	9	116	85	56	59	18.3
281	9	116	85	56	59	18.3
317	10	124	85	56	59	24.2

318	10	124	85	56	59	24.2
703	20	58	95	56	59	26.3
704	20	58	95	56	59	26.3
203	4	62	95	56	59	30.8
204	4	62	95	56	59	30.8
70	1	103	95	56	59	33
69	1	103	95	56	59	33
169	3	59	95	56	59	33.2
170	3	59	95	56	59	33.2
135	2	324	95	56	59	35.3
136	2	324	95	56	59	35.3
1017	28	676	95	56	59	38.8
1018	28	576	95	56	59	38.8
801	17	288	95	56	59	36.8
802	17	288	95	56	59	36.8
940	27	60	95	56	59	40.3
939	27	60	95	56	59	40.3
1216	32	59	95	56	59	41.8
1217	32	59	95	56	59	41.8
506	15	186	95	56	59	44.4
505	15	186	95	56	59	44.4
887	26	189	95	56	59	40.9
888	26	189	95	56	59	40.9
1256	33	854	95	56	59	54.4
1257	33	854	95	56	59	54.4
253	8	116	105	56	59	14.2
254	8	116	105	56	59	14.2
1159	31	124	105	56	59	28.3
1160	31	124	105	56	59	28.3
1084	29	70	105	56	59	20.8
1083	29	70	105	56	59	20.8
1020	28	182	105	56	59	38.8
1019	28	182	105	56	59	38.8
1218	32	58	105	56	59	41.8
734	21	128	105	56	59	41.8
1220	32	58	105	56	59	41.8
733	21	128	105	56	59	41.8
1121	30	236	105	56	59	42.3
1122	30	236	105	56	59	42.3
889	26	83	105	56	59	40.9
890	26	83	105	56	59	40.9
784	22	189	105	56	59	54.4
783	22	180	105	56	59	54.4
1161	31	62	115	56	59	28.3
1162	31	62	115	56	59	28.3
1021	28	255	115	56	59	38.8
1022	28	255	115	56	59	38.8
1221	32	58	115	56	59	41.8
1222	32	58	115	56	59	41.8
1123	30	58	115	56	59	42.3
1124	30	59	115	56	59	42.3
206	4	124	125	56	59	30.8
205	4	124	125	56	59	30.8
137	2	54	125	56	59	35.3
138	2	54	125	56	59	35.3
1023	28	84	145	56	59	38.8
1024	28	84	145	56	59	38.8
255	8	56	205	56	59	14.2
256	8	56	205	56	59	14.2
283	9	58	205	56	59	18.3

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 284   8    59   205 58 59 18.3
 319  10   124   205 58 59 24.2
 320  10   124   205 56 59 24.2
1025  26    64   205 58 58 36.6
1026  26    64   205 58 59 36.6
 171   3    59     5 58 58 33.2
 172   3    58     5 59 56 33.2
 449  14   300    15 59 58 26.7
 450  14   300    15 59 59 26.7
 619  23    57    15 58 58 30.4
 620  23    57    15 59 59 30.4
 706  20    58    25 58 59 26.3
 705  20    56    25 59 59 26.3
 451  14   120    25 58 58 26.7
 452  14   120    25 59 59 26.7
 390  13    63    35 59 58 20.6
 388  13    63    35 59 59 20.8
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